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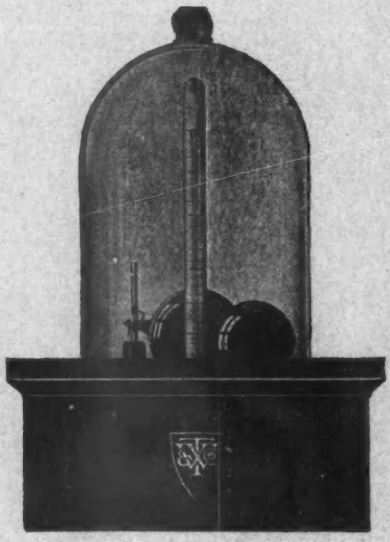

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CANADIAN PUBLIC HEALTH JOURNAL

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Safe Milk*

W. J. BELL, M.B.

Deputy Minister of Health, Ontario

IT is now some four years since I had the privilege of addressing this Association, and although we have not yet attained the objective we set out at that time to reach, we have made a considerable amount of progress.

On the occasion to which I refer, we coined a few new phrases. We referred to raw milk as "contaminated milk"; we introduced the term "safe milk", meaning milk satisfactory for human consumption, produced under sanitary conditions and safeguarded by scientific pasteurization. We enunciated the fact that pasteurization does not clean dirty milk, and we set as our ultimate objective universal pasteurization of the total milk supply. Finally, we enunciated the principle that education must be the avenue through which our objective could be attained, and that that education must include the producer, the distributor and, most important of all, the consuming public.

It is recognized as a fundamental principle that the person who pays for the music calls the tune. The buyer states what he wants and the seller who is alive to the principles governing merchandising in any line tries to determine what the public wants and to supply the commodity. He attempts to market in accordance with public demand, and we therefore must accept as a fundamental requirement the education of the public, following which we may reasonably expect that the demand of the public will be based on intelligent information.

As an outcome of our previous meeting we formed a committee which we called the Ontario Committee for Safe Milk, composed of persons interested in public health and public welfare and representing social service organizations, insurance companies, the milk producers of the Province, the milk distributors, women's organizations, departments of government, and the Canadian Public Health Association.

Under the auspices of this Committee pamphlets have been prepared by experts, dealing with such subjects as *The Production of Clean Safe Milk*, *Pasteurization*, *Should Pasteurization be Universal? Eight Reasons for Making Pasteurization Effective*, and *Safe Milk for the Country Home and Cottage*.

**Presented at the 1933 Meeting of the Ontario Milk and Cream Distributors' Association. Toronto, and published through the co-operation of The Canadian Dairy and Ice Cream Journal.*

Appreciating the importance of this educational effort, the Metropolitan Life Insurance Company undertook to publish four of the pamphlets listed. One pamphlet, *The Production of Clean Safe Milk*, was published by the Ontario Milk and Cream Distributors' Association.

More than 100,000 copies of these pamphlets have been distributed and the distribution is still going on. These publications have had a very important influence in that they have carried reliable information in an easily understood text to the lay public. The press has used these pamphlets generously and has furthered this public educational effort to the end that today more than ever before, the public is demanding clean safe milk. Should anyone desire copies of these pamphlets, either for personal use or for distribution, they may be obtained by writing Dr. N. L. Burnette, Ontario Committee for Safe Milk, Metropolitan Life Building, Ottawa.

You may ask me what is required for the production of a satisfactory milk supply. In this connection we must remember that the preparation of milk for the market is a two-stage process. The first stage takes us up to the point where we have what is called raw milk, ready for delivery to the dairy. It is usually considered that this is the farmer-producer's part of the whole job, and in order to turn out a satisfactory raw milk the farmer-producer must exercise intelligent care and scrupulous cleanliness in production.

Milk is a substance that is very readily contaminated and it may easily be contaminated to such an extent that its value as the most important nutritional element in the whole dietary list may be entirely nullified. The cattle producing the milk must be healthy. The widespread occurrence of contagious abortion and bovine tuberculosis is well known, and it is highly desirable that cattle suffering these infections be excluded from dairy herds. Dangerous bacteria may gain entrance to the milk from the hands of the milkers, and this source of contamination is the most serious individual factor in the spread of milk-borne epidemics.

The bacterial count in milk may be very greatly increased by the use of carelessly cleaned utensils. Milk pails and milk cans should preferably be seamless, but if seams be present, exceptional care must be exercised in cleaning these utensils. Milk cans should be exposed to live steam for at least thirty seconds. Exposure to steam for five seconds is practically valueless. The Ontario Department of Health is working seriously on the problem of methods of cleansing milk containers to make these methods applicable on the farm as well as in the dairy.

Raw milk should come to the dairy in good condition. The milk should be clean and it should be protected during transportation so that it would not be over a temperature of 50 to 55° F. on arrival at the dairy. I know of one dairyman who refuses to accept milk if it is over 60° F. when it reaches his plant. He knows that the quality of the raw product has been reduced by multiplication of such bacteria as have gained entrance even in spite of careful production. Some dairymen seem to be afraid that they will jeopardize their supply if they refuse milk which is not in all respects up to standard. They fear that producers will drift away from them and take their raw supply

to another dairy. If we had adequate regulation in this connection, it would be possible to prevent producers becoming drifters.

Distributors should make frequent use of the sedimentation test and the temperature test on the milk as it is received at the dairy. Evidence of gross dirt by the sedimentation test is fairly good evidence of careless production, with which we always find associated a high bacterial count, and an unsatisfactory sedimentation test should be sufficient justification for refusing to accept any shipments of milk.

We next come to dealing with the milk after it has been received at the dairy. This may be briefly summed up as follows: The milk should be promptly pasteurized, rapidly chilled and kept at a temperature as near 45° F. as possible until delivered to the consumer. We should stipulate here that the process of pasteurization should be properly conducted and for this purpose we require satisfactory equipment, properly installed and free from defect either in design or arrangement. A further fundamental requirement is intelligent operation by a competent, trained operator. There is no greater source of danger in a dairy than an ignorant, careless operator. Our experience has proved to us that this type of man, even though he have the best equipment in the world, cannot be relied upon to turn out a satisfactory and properly pasteurized product.

Milk should not be allowed to be labelled "pasteurized" until a thorough inspection has been made of the whole process, including equipment and technique of operation, and approval given by a qualified inspector. Not only this, but re-inspection should be made at irregular intervals, without previous notice of the inspector's visit. An efficient operator will always be ready for an inspector's visit without any dress parade: the inefficient man should be weeded out in the interests of public safety.

Finally, the same scrupulous cleanliness with regard to equipment, utensils, containers and general operation that is required of the producer should be equally applicable to the distributor.

From the point of view of the consumer we must appreciate the fact that pasteurization adds to the cost of milk production, but the public should accept this added cost as health insurance, and I believe that with an intelligent, informed public this will not be a matter of difficulty. The consuming public will very readily find out that cheap milk is potentially dangerous milk, and that safe milk is worth paying for.

Now while scientific pasteurization will safeguard milk and will prevent a development of specific milk-borne infection on the part of the consumer, still we should not allow milk to become contaminated beyond a minimum point, and at the risk of possibly being accused of laboring the point too much, may I explain why temperature control is extremely important. At high temperatures organisms multiply rapidly in milk, probably the best cultural medium we have for the growth of organisms causing specific disease in man. Pasteurization will kill these organisms but during the time that they are alive they produce poisonous products. These foreign substances in the milk may be of such an amount that, while they do not set up outbreaks of

specific disease, they may quite readily cause intestinal upsets, especially in very young children.

We therefore sum up our story on the safeguarding of the milk supply with three points:— (1) dirt control
(2) temperature control,
(3) scientific pasteurization.

There are some other aspects of the milk business which might be discussed but which are somewhat out of my field, as, for example, surplus milk, price fixing, etc. However, I feel that a word here respecting price fixing would not be out of place. It is reasonable to expect that the producer should be paid a satisfactory price for a satisfactory raw milk and that the distributor should receive a satisfactory price from the consumer for a satisfactory milk properly safeguarded by pasteurization. Some plan must be devised to eliminate a type of unfair competition, the worst feature of which is careless production which gives the consumer an unsatisfactory, unsafe milk. I believe that a marketing method should be devised which would involve the fixing of a uniform price that would properly repay those engaged in the business for the effort and expenditure entailed. I do not believe that the consumer will ever be safe until cut-rate methods that mean cut-rate attention to sanitation and processing have been eliminated. Success in this effort to provide a safe milk supply will be attained only by men who are making a profit on their work.

I am vitally interested in the quality of the milk that is being supplied to our consuming public. We cannot get any article at a price less than it costs to produce it; there must be a profit and a reasonable profit, otherwise we cannot expect to maintain high standards of quality and efficiency. Looking toward the future, we now have producers who are intelligent and informed; we have distributors who are equally intelligent and informed; and we have a consuming public who are from day to day becoming increasingly better informed as to the importance of safe milk, who are demanding safe milk and who are exhibiting a willingness to pay for it.

We have not yet arrived at universal pasteurization throughout this province. We will not arrive at that point for some considerable time yet, but I feel that the time has arrived for province-wide distribution of pasteurized milk in our cities and large towns. I am not interested in just having a pasteurization ordinance on the statute books. What we need is scientific pasteurization of clean milk that will put on the markets of our province a product on which the public can depend. I feel that public support and public demand in this connection have reached this point. We are well along the way and I believe that our objective is in sight.

Brucella Abortus Infection in Cattle in Relation to Milk*

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BOVINE infectious abortion (Bang's disease) has long been a serious problem of the livestock owner and veterinarian, and in recent years it has become a public health problem, on account of the pathogenicity of *Br. abortus* for man. Certain findings in our work in connection with the eradication of Bang's disease from infected herds are recorded in this communication.

Infection of the mammary gland in positive, suspicious, and negative cows

One hundred and fifty samples of milk have been examined by guinea-pig inoculation and cultures on liver agar alone and with the addition of methyl violet[1]. Guinea-pig inoculation has proved to be more satisfactory than cultures in our hands. Twenty-six of these cows were negative† but were in herds containing infected animals, 22 were suspicious†, and 102 were positive†.

Infected Milk from Negative Cow

Brucella abortus was recovered from guinea-pigs injected with milk from a negative animal in a mixed herd in November, 1931. This animal became suspicious in September, 1932, at which time the placenta and colostrum were negative by culture and animal inoculation. As this herd contained infected animals it is impossible to say whether this blood reaction appeared as a result of the first infection or a subsequent one. In 1931 repeat tests failed to demonstrate the organism again. This strain was aerobic on primary culture and, as this cow had been vaccinated with live culture some years previously, it is possible this may have been of vaccinal origin. It was of low virulence for guinea-pigs.

Cooledge,[2] King,[3] and Fitch and Lubbehusen[4] have reported the isolation of *Br. abortus* from negative cows. The writer has reported guinea-pigs that were negative to the agglutination and complement fixation tests but from which *Br. abortus* was recovered on culture.[5] Some of these animals had enlarged spleens while others showed no lesions. The recovered organism gave rise to agglutinins when injected into other guinea-pigs. Two guinea-pigs injected with the same milk sample failed to develop agglutinins, but *Br. abortus* was recovered from both. Gaiger and Davies[6] recently reported that a negative guinea-pig harboured the organism.

*Presented at the Christmas Meeting of the Laboratory Section, Canadian Public Health Association, Toronto, December 22, 1933.

†*We have considered as suspicious, animals showing partial or complete agglutination in 1:50, and as positive those reacting in 1:100 and higher.*

Suspicious Cows

Milk samples from the 22 suspicious cows did not yield *Br. abortus* by culture or animal inoculation. *Br. abortus*. however, was recovered from the placenta of 3 out of 10 of these animals. One of these cows aborted twins in March. She had been vaccinated the previous August with live culture vaccine but was negative to the agglutination test in January, suspicious in March and again negative in May. There was a very heavy placental infection with a virulent, microaerophilic strain of *Br. abortus*, which on injection into guinea-pigs gave rise to agglutinins, and also paralleled our regular antigen in agglutinability. This case is unusual because the abortion was due to *Br. abortus* and yet the serum titre rose to only 1:50 and soon returned to negative. The second suspicious animal from which the organism was recovered had previously given a positive reaction, and the third became positive shortly after this examination was made.

Positive Cows

Milk samples from 102 positive cows yielded *Br. abortus* in 52 cases (approx. 50 per cent). This organism was recovered from one cow with a partial reaction in 1:100, from 8 of 36 cows with a serum titre of 1:100 (22 per cent), from 7 of 11 with a titre of 1:250 (64 per cent), from 6 of 11 cows with serum titre of 1:500 (54 per cent), and from 30 out of 43 animals with serum titre of 1:1,000 (70 per cent).

The significance of this lies in the fact that the serum titre does not indicate whether or not the udder is infected. It is true that cows with the higher titres yielded a higher percentage of recovery of the organism, but it was isolated from 22 per cent of cows with the lowest titre considered as positive (1:100).

Gilman[7,8] reported that he was unable to recover *Br. abortus* from the udders of cows with a serum titre lower than 1:320. At the opposite extreme Klarin[9] states that when the blood agglutinin titre was 1:100 or more, *Br. abortus* was found in the milk in more than 50 per cent of the cases; when the titre was 1:70, it was found in 19 per cent; and when it was 1:10 to 1:20, 3 per cent of the udders were infected. Such reactions as the last, with the antigen employed by us, are not taken into consideration, and if this worker were using a heavy antigen it would mean nothing to make comparisons. Cotton[10] refers to infection of the udder in 3 of 4 cows with serum titres of 1:100, but considers this unusual.

In connection with mammary gland infection, the experiment of Mitchell and Duthie[11] is interesting. They removed the udders of two infected cows. The serum titre of one fell to within normal range and that of the other dropped sharply, but this animal had not become negative at the time their experiment was reported.

Certified and Pasteurized Milk

The writer has referred elsewhere[5] to the recovery of *Br. abortus* and also tubercle bacilli from certified milk. We later had the opportunity of confirming the presence of Bang's disease and tuberculosis in the animals from which the milk had come.

Proper pasteurization is an efficient safeguard from the standpoint of infection from ingestion of milk. Carpenter and Boak[12] found that 205 samples of pasteurized milk and cream from 38 cities and 12 villages were negative for *Br. abortus* by guinea-pig inoculation. They also found that temperatures of 142°F. and 145°F., for 20 and 30 minutes, on the most virulent strains of *Br. abortus* were satisfactory for pasteurization. We have examined samples of pasteurized milk from herds known to be badly infected, with negative results. Under experimental conditions our strains have been destroyed by 10 to 15 minutes at 140° F., in sealed ampules. Murray, McNutt and Purwin[13], using a standard pasteurizing outfit, found that pasteurization was effective in 3 minutes at 62°C. (143.6°F.) as shown by milk tests and in 30 minutes as indicated by tests of the foam. Animal inoculation tests of the foam were not made before this time. With the lid of the pasteurizer open, viable organisms were recovered after 30 minutes. The absolute necessity of a flush gate-valve was also shown.

It is interesting to compare the recovery of *Br. abortus* from 50 per cent of positive cows examined with the much lower incidence of infection in the fetal membranes of positive cows that give birth to living calves at full time. Such animals have developed sufficient immunity to prevent invasion of the placenta or to permit, at most, an infection so slight that it has not interfered with the development of the fetus. We have previously recorded[14] the recovery of *Br. abortus* from the membranes of 5 out of 34 full time, positive cows (15 per cent). The organism was isolated from the milk of 18 out of 32 of these same animals (56 per cent). The number of organisms in the placentae of these cows was small compared with the number in the majority of aborted fetal membranes. Mitchell and Humphreys[15] found that positive animals that went through a normal pregnancy, and were examined soon after parturition, failed to give a growth of *Br. abortus* in all cases but one.

Agglutinins in milk are apparently produced in the mammary gland. The titre of the milk serum is in some cases much higher than that of the blood serum[16]. We have encountered several such instances. In one, the serum titre was 1:250, the left front quarter was 1:1,000, the right front 1:250 and the other two were 1:100.

Reduction of Milk Yield due to Pathological Termination of Pregnancy

Rich[17] compared 28 heifers from the same sires. Fourteen heifers aborted and 14 calved normally. The aborting group gave 16.5 per cent less milk than the normal group.

Fritz and Barnes[18] have recently published figures on 14 State Institution herds which show improved milk production in these herds after they were freed from Bang's Disease.

We have been unable to obtain evidence that regular breeding, positive cows, which carry living calves to full time, give less milk than similar negative animals, but there is no doubt of the direct result of abnormal terminations of pregnancy, and indirect results of failure to conceive, upon the milk yield.[19]

In one herd, 21 negative cows in 63 years gave 553,581 lbs. of milk, an average of 8,787 lbs. Seventeen positive cows in the same herd gave 508,716 lbs. in 72 years, an average of 7,065 lbs. This is a difference of 1,722 lbs.

per cow (19.5 per cent) in favour of the negative group. The following are examples of cows that aborted:

No. 3	Normal calving	8,225 lbs.
	Aborted at 7 months	5,070 lbs.
	Normal calving	12,161 lbs.
No. 4	Normal calving	11,039 lbs.
	Aborted at 8 months	4,050 lbs.
No. 5	Normal calving	16,203 lbs.
	Aborted at 5 months	7,850 lbs.

In this herd, 6 positive cows in 8 normal years gave 83,888 lbs. The same six cows in 8 aborting years gave 56,351 lbs., a difference of 27,537 lbs. (33 per cent).

In another herd, where abortions were few, the difference between the amount of milk given by 10 negative and 10 positive cows in 4 years was negligible.

In a mixed herd, 15 negative cows gave 18 per cent more milk in 11 months than 15 positive animals during the same period. There were more abortions and dead calves in this herd, among the positive animals, than in the preceding group.

In yet another herd of positive and negative animals there was a difference of 17 per cent in favour of the negative group.

Reduction of milk yield and shorter lactation periods may follow the birth of full time dead calves, as the following examples will show:

No. 318	First year. Milked 12 months	11,049 lbs.
	Second year. Still-born calf.	
	Went dry in 7 months	5,512 lbs.
No. 320	First year. Milked 12 months	9,411 lbs.
	Second year. Still-born calf.	
	Went dry in 8½ months	5,410 lbs.

The earlier the abortion, the poorer is the yield of milk as a rule. An abortion may not make any appreciable difference in the milk flow of a lactating cow. This is perhaps most noticeable when an animal aborts about the 6th or 7th month of lactation. There may be a slight increase or the milk flow may continue the same. Nevertheless, only the same amount of milk is obtained from the two pregnancies that might have been expected following the first normal parturition.

SUMMARY

Brucella abortus was recovered from the milk of a cow the blood serum of which gave a negative agglutination test. It appeared to be a vaccinal strain. *Br. abortus* was also isolated from guinea-pigs which gave negative agglutination and complement fixation tests.

Brucella abortus was isolated from the placentae of 3 out of 10 cows, the sera of which gave suspicious (1:50) agglutination tests. One had aborted and the agglutinin titre never exceeded 1:50. One had previously given a positive reaction, and the other became positive shortly afterwards. The organism was not recovered from the milk of twenty-two cows with suspicious (1:50) agglutination tests, including the ten animals previously mentioned.

Brucella abortus was isolated from the milk of 52 out of 102 (50 per cent) cows showing positive agglutination tests in serum dilutions of 1:100 or greater. It was recovered from the milk of one animal with a partial reaction in 1:100 and from 8 of 36 milk samples from cows with a titre of 1:100.

Proper pasteurization has been shown to be an efficient safeguard against exposure to infection by the drinking of milk.

Br. abortus and *M. tuberculosis* were isolated from a sample of certified milk.

The incidence of infection in the placentae of full term, positive cows that gave birth to living calves was shown to be low. *Br. abortus* was recovered from 5 of 34 placentae of such animals (15 per cent) and from the milk of 18 of 32 of this same group (56 per cent). The number of organisms in the fetal membranes of the full time animals was small in comparison to that in aborted fetal membranes.

No evidence was obtained to suggest that regular breeding, positive cows, that have healthy calves at full time, give less milk than negative animals.

Abortions and still-births may cause a considerable loss in milk, due to shortened lactation period and actual reduction in quantity.

ACKNOWLEDGMENTS

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Undulant Fever in Ontario

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UNDULANT fever is a disease in man due to the same organism that causes contagious abortion in cattle. This relationship was firmly established in 1924 by Keefer[1] cultivating the organism from the blood of a patient whose temperature chart showed the typical undulant character. Man contracts the disease by drinking infected raw milk or by contact with infected animals, especially at the time of parturition, or by handling infected meat. It is common for cows to harbour the organism and excrete it in the milk without their showing any signs of disease. Michell[2] found in the serological examinations of bovine sera that about 20 per cent of the animals tested were infected. Therefore, the chance of exposure of those working on dairy farms and in abattoirs and of those who drink raw milk is great. In fact, the organism can be obtained from raw milk samples, certified and not certified.

Though the disease in man has a relatively low but not insignificant fatality rate, it is usually completely disabling, very distressing, prolonged for weeks and months, recurrent, and not amenable to any specific treatment. It is characterised by recurrent fever with drenching sweats, headache, general pains, lassitude and generally complete disability of months' duration.

The first reports[3, 4, 5] of undulant fever recognized in Ontario appeared in this journal in June and July, 1928. On July 1, 1928, in the Laboratories of the Department of Health, Ontario, examination of whole blood specimens for evidence of typhoid infection was supplemented by examination for evidence of paratyphoid and undulant fever, and in 1930 tularemia was also brought under the scope of the examination. In January, 1929, McKay and McNabb[6] reported 17 cases.

In Table I there are shown the results of agglutination tests of blood specimens received for diagnostic examination in the past five years, 1929-1933.

TABLE I

RESULTS OF AGGLUTINATION TESTS ON BLOOD SPECIMENS RECEIVED AT CENTRAL LABORATORIES, DEPARTMENT OF HEALTH, ONTARIO. 1929-1933, INCLUSIVE

Period Examined	Number Examined	Positive Agglutination for B. Typhosus		B. Paratyphoid B.		Br. Abortus	
		No.	Per cent	No.	Per cent	No.	Per cent
1929	669	100	15.9	8	1.2	29	4.3
1930	1125	193	17.1	30	2.7	54	4.8
1931	1985	245	12.3	184	9.3	75	3.8
1932	1373	169	12.3	43	3.1	64	4.7
1933	2227	129	5.79	60	2.69	67	3

The rapid increase in the number of cases of undulant fever identified from year to year is evident. This is undoubtedly due to the fact that physicians have learned more and more to appreciate the possibility of protracted illness with unsatisfactory diagnoses, of fever or lassitude of unknown origin being undulant fever and have consequently submitted an increasing number of blood specimens for such examination. There is no doubt that, as knowledge of the disease becomes more widely disseminated, more cases will be recognized. It is to be noted that the amount of undulant fever already identified throughout Ontario constitutes a problem quite comparable with that of paratyphoid fever. It should be pointed out that many of these cases will be ill and disabled for months and that some will show recurrences from year to year.

The infection is very general and widespread throughout the province. This is indicated by the fact that at least one case has occurred in every county in southern Ontario.

Distribution of Cases by Age

Hardman[7] found the distribution by age of 80 cases in Ontario to be as shown in Table II.

TABLE II

AGE DISTRIBUTION OF 80 CASES OF UNDULANT FEVER

Age	No. of Cases
0–4	0
5–9	3
10–14	4
15–19	4
20–24	7
25+	62

The greater number of cases appear in adults, with but few in children, but it is significant that 3 cases were identified in the 5-9 age group. While infection from contact with animals or meat would be expected to give more cases in adults, the milk-borne infection would be expected to give a greater proportion in children. Why the actual findings in this regard in Ontario, as elsewhere, are at variance with what might be expected has not been adequately explained. It may be that childhood presents a different clinical picture of this infection and that the cases are thereby missed. On the other hand, it may be that susceptibility to the disease increases with adolescence and maturity, as is apparently the case in cattle. Our knowledge of this phase of the question is, however, too limited to permit of final judgment.

Distribution by Sex

Of the 80 cases, 58 were males and 22 females. This disproportion is accounted for by the fact that 44 of the male cases had been in contact with dairy cattle or worked in an abattoir. The female cases were, for the most part, housewives resident on farms having infected herds.

Source of Infection

In a previous review[8] of 136 cases in Ontario, it was found that in 13 cases there was no possibility of contact infection. These included 3 physicians, 1 clergyman, 2 nurses, 1 dietitian and 6 other urban residents. The dietitian drank milk from a herd where it was later found that 8 of 11 cows gave positive agglutination tests. One of the physicians drank milk from a herd known to be infected. In the contact group were 3 veterinary surgeons (one a laboratory infection) and 1 meat packer. The remainder, 119, were workers on dairy farms and were thus exposed through contact and through drinking infected milk.

Laboratory Identification

The agglutination test has been found the most practical laboratory procedure. The results of the rapid slide agglutination are in close agreement with the results of tube agglutination and each test serves as a check on the other. In two instances, in our laboratory, the complement fixation test was positive where agglutination was negative. By culturing the clots in dextrose beef broth for prolonged periods (10-21 days) and subculturing after 10-12 days' incubation in an atmosphere in which the oxygen was partly replaced by carbon dioxide, the organism can be recovered.

SUMMARY

Though the possibility of infection in man with the organism causing contagious abortion in cattle was not established until 1924 and the first reports of such infection occurring in Ontario appeared in 1928, 480 cases of infection have been identified in the past 5 years, 1929-1933, in Ontario by the Central and Branch Laboratories, Department of Health. It is probable that many more cases will be identified when knowledge of this disease is more widely and thoroughly disseminated.

Cases have occurred in every county of southern Ontario.

Many of the cases contracted the infection through drinking raw infected milk. In several instances the herd which supplied the milk was shown to be infected.

General pasteurization, commercial or home, is the only practical means, at present, of preventing the milk-borne part of undulant fever infection.

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Milk and Its Relation to Tuberculosis

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THE results obtained in a study comprising 300 tuberculous children in Toronto show that in the group under 14 years of age, 15 per cent of extra pulmonary tuberculosis was caused by the bovine type of the tubercle bacillus; e.g. tuberculosis of bones, joints, lymph nodes, kidney and skin. And, furthermore, the highest incidence of bovine infection occurred in the region of the lymph glands of the neck.

Without exception, the children harbouring infection with the bovine tubercle bacillus came to Toronto for treatment from widely scattered parts of the Province of Ontario where pasteurization of milk was not carried out. The history invariably revealed the fact that the child had always, or for some time, been fed raw milk. In one instance, a small outbreak of bovine infection occurred in a group of children living in the same neighbourhood (a suburb of Toronto) almost on the same street, and supplied by one dairy distributing raw pooled milk.

Physical examination and X-ray of all children harbouring an infection with the bovine tubercle bacillus failed to show any evidence of tracheo-bronchial or parenchymatous disease of the lung, the evidence in all cases definitely pointing to the alimentary route of infection and to milk as the vehicle for the transmission of the disease.

Whenever possible, in the cases studied, we endeavoured to obtain suspected milk for examination and guinea pig inoculation. In three instances we succeeded in demonstrating bovine tubercle bacilli in the milk consumed by the infected child; in one case we were able to trace the infection to the actual source, the cow from which the milk was obtained and from which the disease was transmitted to the human host, and thus bring forward the indubitable evidence of the source of the childhood infection.

In this study, as stated above, it was further noted that not a single case of bovine infection had been encountered in the Toronto group of children. This striking fact demanded explanation. Enquiry revealed the fact that the majority of the children harbouring an infection with the human type of the tubercle bacillus gave a history of contact with human tuberculosis. Physical examination, X-ray, or both, showed evidence of tracheo-bronchial or parenchymatous disease of the lung, the evidence pointing to the respiratory route of infection.

It appeared on further enquiry that at the time of this investigation 99.8 per cent of all milk sold in Toronto was pasteurized. We therefore undertook a study of raw milk, the purpose being twofold: firstly, to determine the incidence of tubercle bacilli in raw milk in this community, and, secondly, to confirm the observation that commercial pasteurization of milk, which consists in heating the milk to 142° – 148° F., holding it at that temperature

for 30 minutes, then rapidly cooling it to 50° F., renders the milk supply safe as far as the bovine tubercle bacillus is concerned. We believe that, from an economic standpoint, bovine tuberculosis is the most important communicable disease transmitted through milk.

With the co-operation of a large dairy company, all the milk from one milk route, as it was received from the farms, a total of 200 samples of milk from individual cans, was examined for tubercle bacilli. This milk represented the usual class of raw milk which comes from herds which are not tuberculin tested. The milk was labelled in such a manner that we could trace each infected sample to its individual source.

Eight samples, representing as many different sources of supply (farms), yielded tubercle bacilli on direct examination and guinea pig inoculation. This gives an incidence of 4 per cent.

Nevertheless, this low incidence of infected farm milk is of greater significance than at first anticipated. The milk, at the premises of the dairy, is pooled in vats for pasteurization. On re-examining 100 samples of pooled raw milk prior to pasteurization we found tubercle bacilli in 26 per cent of samples. It is evident, therefore, that individual samples of infected milk coming from some one source may be sufficiently heavily infected to lead to a contamination of the whole of the pooled product. The efficient pasteurization of milk eliminates the menace of bovine tuberculosis. One hundred samples of milk examined immediately after pasteurization proved free from tubercle bacilli on guinea pig inoculation.

The truth of the above statement is forcibly brought out in the fact that up to the present time, in the city of Toronto, where pasteurization of milk is compulsory and where it has been rigidly enforced since 1915, not a single case of bovine infection has been encountered in the generation of children brought up on pasteurized milk.

From a public health standpoint, the importance of bovine tuberculosis in a community lies not only in the incidence in which the disease exists, but in the ease with which the disease, leading to disablement, disfigurement, occasionally resulting in death of the child, and entailing a great economic loss, can be controlled. The effective pasteurization of milk offers the best solution for the prevention of bovine infection in childhood. And here we wish to stress the point that pasteurization can be considered safe only when carried out under rigid and scientific supervision.

The excellent results obtained in Toronto from the standpoint of eradication of bovine tuberculosis is attributable solely to the efficient pasteurization of milk, and affords an unchallenged demonstration of the control of bovine tuberculosis in man.

SUMMARY

In a study of 300 tuberculous children in Toronto, it was found that 15 per cent of the extra-pulmonary tuberculosis (e.g., bone, joint, lymph nodes, kidney and skin) was due to the bovine type of tubercle bacillus.

Infection with the bovine type occurred most commonly in the region of cervical lymph glands.

All the cases of infection with the bovine type had used raw milk and came from points outside of Toronto. The clinical investigation indicated the alimentary route of infection.

The majority of children infected with the human type gave a history of contact with human tuberculosis. The clinical investigation indicated the respiratory route of infection.

Of 200 samples of *unpooled* raw milk examined, 8, or 4 per cent yielded tubercle bacilli on direct smear and guinea pig inoculation.

Of 100 samples of *pooled* raw milk, 26 yielded tubercle bacilli.

Of 100 samples of the same milk, pasteurized, none showed tubercle bacilli on guinea pig inoculation.

This finding is confirmed by the fact that not a single case of bovine tuberculous infection has been encountered in this generation of children raised on pasteurized milk in Toronto, where pasteurization is compulsory and has been rigidly enforced since 1915.

Disease-Producing Organisms in Milk

EXAMINATION of graded and ungraded milk samples had revealed the frequency with which cow's milk was infected with pathogenic micro-organisms. While examination of twenty-six samples of certified milk failed to detect the presence of tubercle bacilli, it did show that seventeen samples contained *Br. abortus* and sixteen samples mastitis streptococci. Of thirty-nine Grade A (T.T.) samples, one contained tubercle bacilli, thirty-one *Br. abortus,* and twenty-nine mastitis streptococci. A large proportion of these milks, belonging to the two highest grades, neither of which was allowed by law to be pasteurized, was therefore found to be contaminated with organisms potentially pathogenic for human beings. Samples of raw milk coming into London in 3,000-gallon tanks were examined both before and after low-temperature pasteurization. Of forty-three samples of raw milk every one contained virulent tubercle bacilli, while at least twenty-seven contained *Br. abortus.* Of the same number of milks after pasteurization not a single one contained either of these organisms in the living state. Discussing these results, the authors laid stress on the necessity of pasteurizing milk for the protection of the human population, and on the desirability of eradicating tuberculosis, contagious abortion, and mastitis from cattle in order to obtain a healthy animal population. There was no reason why these two policies should be in any way incompatible.

—F. C. Minett and E. J. Pullinger, Roy al Veterinary College, London. Br. Med. J., 1080, Dec. 9, 1933.

Home Pasteurization of Milk

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WHEN one considers that nearly half of our Canadian population lives in an environment more strictly rural even than that of the incorporated village, it is readily realized that extremely radical changes in milk distribution, changes that are hardly contemplated, would be necessary before this large proportion of our population could be served by common or group pasteurization as we have come to regard the term. In this population group, milk-borne disease in epidemic form is limited in each instance to the extent of the distribution of the milk supply involved and the extent of the distribution is confined to one or, at most, a few families. But, though no epidemics involving any great numbers occur, this does not mean that there is no milk-borne disease in this group. The milk from a single cow on an isolated farm is as apt to be infected as that from any cow in the larger herds; the family milker and the family milk handler are as apt to contaminate the family supply as is the milk handler on the dairy farm or in the larger dairies. The amount of sickness due to milk-borne infection in the rural population is unknown because such disease is not reported and does not often come under the scrutiny which establishes its source. The widespread distribution of bovine tuberculosis and contagious abortion among our cattle and the similar widespread distribution of infected handlers among the rural population leaves no doubt that the isolated small supply of raw milk, even the individual family supply, has its menace just as in the larger population groups. For that rural group, therefore, where no common pasteurized supply is available, pasteurization in the home must be practised. In spite of the facility of home pasteurization, it is difficult to attain because the rural dweller is very apt to recognize no hazard in raw milk and the absence of spectacular epidemics in his environment makes conviction difficult. Home pasteurization is readily accomplished in two ways:

(a) Heating the milk in a double boiler to 145° F. and removing to the back of the stove where it is allowed to stand for 30 minutes. The heat of the water in the boiler will prevent any great loss in temperature of the milk during that period. A thermometer is necessary and one can be purchased for about sixty cents.

(b) Bringing the milk to the boiling point, and then cooling at once. This is not as satisfactory an arrangement, although it is more convenient and requires less time. It produces a boiled taste, and a scum forms on top, which may be skimmed off.

One of the difficulties of home pasteurization is the absence of proper cooling facilities and the time required to bring this about. This is not an insurmountable obstacle and the protection secured will more than compensate for the inconvenience.

The Importance of Dairy Farm Inspection

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PEOPLE have learned by bitter experience that whenever the milk has to be obtained from distant and largely unknown sources there is need for responsible control to regulate the methods of production and distribution of milk. The production and handling of milk require skill and common sense, for it must be produced economically, marketed expeditiously and carefully guarded by sanitary measures on account of its susceptibility to infection.

Therefore, one of the first essentials in milk control work is that the regulations should require every milk shipper and vendor of milk to be licensed before offering his product for sale. To obtain this licence he should contract to observe the provisions of the act respecting the production and sale of milk for human consumption and all by-laws of the municipality where the milk is to be sold, to keep his cattle and premises sanitary, and to handle his milk in a manner satisfactory to the inspection staff of the local board of health. Neglect or default in this respect should render him liable to forfeiture of his licence. This is important and the key to the whole situation.

In this way the inspector becomes familiar with the conditions at the farm and he can instruct and be very helpful to the farmer by carefully examining his dairy herd or advising the proper care for best returns. Very often non-profitable cows can be pointed out and the farmer greatly assisted in the proper channel for a profitable business. This should be one of the inspector's objectives, as once a profit can be realized there will be no difficulty in getting all necessary improvements installed.

The work of the inspector should be based on *scientific common sense*, taking carefully into consideration the opinions and views of all classes who are concerned in the milk problem. This broader view spells better co-operation and better relations between producers and officials of the health departments.

When inspection was first started there was fear, on the part of the milk producer, that he would be put to such expense that he would be unable to comply with the requirements. As a matter of fact, the opposite effect was produced. As the consumer began to understand the care taken in the production of milk he was willing to pay more for it. The farmer now understands that what is best for the consumer is also best in the long run for the producer. There has also been a noticeable increase in the amount of milk per cow. The producer fully realizes the fact that to get best returns from his herd the cows must be free from disease, comfortably stabled, and kindly treated. The importance of light and ventilation cannot be over estimated. The cow should have as much liberty as possible in a swinging stanchion so

that she can groom herself. There should be plenty of clean fresh water. The cow will readily respond to such treatment by her almost immediately increased milk flow.

After the stable is properly attended to and the herd made comfortable, the next in importance is a place to cool the milk. Milk should be cooled in a clean milkhouse immediately after it is taken from the cow. The milkhouse should be entirely separate from the stable, but I am of the opinion that an air space of two, three or four feet between the stable and milkhouse is quite sufficient. We have found that when the milkhouse is twenty feet or more from the stable the can of milk is left too long around the stable before it is immersed in the vat of ice water. This is especially true in stormy weather. For that reason we are having good results when it is made easier for the dairyman to step from his stable to milkhouse and he is not too exposed to bad weather. The can, when full, can thus be placed immediately in the vat of cold water, pending its delivery to the pasteurizing plant in the city.

No important part of the dairy work is so often neglected as the cleansing of the milk utensils. They may look perfectly clean and yet be very dirty. In other words, dirt in our milk utensils is more than dirt. It includes living organisms which are waiting for a chance to multiply, an opportunity which the utensil often gives. Therefore, the dairyman and all others who are interested should think in terms of bacteria and not simply visible dirt. What holds true of the milk pail is true for every other utensil with which the milk comes in contact. Bacterial counts are by far the most reliable check we have on the production of clean milk. Milk with persistent high counts should be investigated as to methods and general cleanliness, and, if necessary, the supply should be excluded from the municipality and the licence for selling cancelled.

It has been shown that milk, for a time after drawing, actually takes in oxygen and gives off carbon dioxide. When an odour is in the atmosphere breathed by the cow the milk will take in that odour. At an experimental station in the United States a cow was made to breathe garlic odour and in twelve minutes from the starting her milk was so flavoured. When the cow ate garlic the milk showed the flavour in one minute. In both cases the flavour continued for a long time because the odour had permeated the tissues of the cow. We have noticed the same condition especially in the spring and the fall when cows have access to new clover or turnip tops or old ensilage. One can picture an average cow in an average stable with average ventilation and picture that cow breathing all day and night the stuffy or rank odours of the stable. She becomes permeated and saturated with whatever smells there are present.

The subject is a broad one. Milk hygiene involves some knowledge of the physiology of cows, especially with relation to breeding, lactation, and nutrition; of comparative pathology, particularly the various diseases of the udder of the cow, the abnormal conditions that affect milk secretion and the infectious diseases of cattle and of man that may be transmitted by milk. It should be accepted as a general principle that the milk of cows suffering from

any febrile, inflammatory or septic condition is unfit for human food. Special emphasis should be laid on this rule in case of any affection of the udder or teats. One of the most common pathological conditions to which cows are subject is inflammation of the udder, technically known as mastitis. The milk drawn from cows thus affected must be regarded as highly dangerous when used for food. It is important to recognize cases of mastitis at an early period and the inspector should be on his guard and especially should he lose no opportunity in advising the dairyman proper measures to prevent the losses in our dairy herds, for it is not only of public health significance but it is, as well, of great economic importance to the dairyman.

It therefore behoves the producer to see to it, if he wishes an increased consumption of milk in cities and towns, that his cows are free from disease, comfortably housed in clean hygienic stables, regularly and properly fed, supplied with pure water, kept scrupulously clean, kindly treated, and milked under the most sanitary conditions, and that the milk is kept cold and free from odours until final delivery.

Epidemics in Canada due to Milk-Borne Infection*

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IN presenting herewith the table of epidemics traced to milk, it is fully appreciated that the figures by no means represent the amount of infection really due to milk. They represent only those epidemics which were brought to the attention of the provincial authorities or the local authorities of the twenty-four largest cities in Canada and in which these authorities were able, on investigation, to incriminate the milk supply. The figures do not show the unknown amount of disease, either less, equal to or greater than that shown in the table, (a) actually due to milk though investigation failed to incriminate it; (b) due to milk, occurring in epidemic form but never coming to official attention, let alone investigation; (c) due to milk, occurring sporadically, but recognized as milk-borne by neither patient nor physician,

**At the request of the Editorial Board, Mr. Murray has kindly brought up to date the statistics which accompanied his paper, "Milk Sanitation in Canada", published in the June, 1932, Journal.*

and information in regard to which never reached the local medical officer—usually the general practitioner in the rural or semi-rural municipality.

The fact that but 6 epidemics were recorded in the 14-year period 1906-1919, and 42 in the 14-year period 1920-1933 does not indicate that milk-borne disease was more prevalent in the latter period but clearly shows the results of more active participation of the health authority, local and provincial, in the investigation of the spread of disease. It is appreciated, too, that this table does not include the amount of undulant fever and of bovine tuberculosis due to milk.

It is regretted that the full details of each epidemic enumerated could not be given. Each has its own story, its own lesson—the one common factor being the milk supply. The following notes on a few of the epidemics which have occurred since 1930 are of interest.

1930. Montreal, Quebec. Typhoid.

The epidemic of 96 cases and 12 deaths was traced to raw milk from a producer who allegedly had placed contaminated ice in his milk before shipping to Montreal. Upon its arrival the milk was bottled without being pasteurized.

1931. Hampton, New Brunswick. Typhoid.

This outbreak was caused through a carrier returning unwashed milk bottles to a dairy farmer who neglected to sterilize the containers.

1931. La Pérade, Quebec. Typhoid.

This village has a population of 926. The milkman was infected with typhoid through drinking polluted water. He probably conveyed the infection to his raw milk supply and the disease was subsequently contracted by his customers.

1931. Dauphin, Manitoba. Septic Sore Throat.

This was traced to a raw milk supply. On submitting the milk to pasteurization the epidemic was arrested. After pasteurizing the milk for several weeks, the sale of the raw product again was permitted and no further cases developed.

1932. St. Maurice Valley, Quebec. Typhoid.

This epidemic is believed to have been caused by infected cheese made from raw whole milk. The milk was infected with typhoid from two producers in whose families there were six cases of typhoid fever. The cheese was sold and consumed in the St. Maurice Valley, a region of the province with a population of 95,000, including four cities, one town, eight villages and twelve rural municipalities.

1933. St. Catharines, Ontario. Paratyphoid.

This outbreak was traced to milk. A competent observer expressed the opinion that these cases would not have occurred had there been no outside toilets.

1933. Carman, Manitoba. Typhoid.

This outbreak was traced to a raw milk supply. The milk was apparently infected by a carrier who had been milking the cows.

EPIDEMICS FROM MILK-BORNE DISEASE IN CANADA AS RECORDED BY PROVINCES AND MUNICIPALITIES

Year	Municipality	Province	Disease	Cases	Deaths
1906	St. John	New Brunswick	Typhoid	40	3
1912	Winnipeg	Manitoba	Typhoid	92	7
1913	Calgary	Alberta	Scarlet	13	0
1916	Winnipeg	Manitoba	Typhoid	23	0
1918	Quebec City	Quebec	Typhoid	23	2
1919	Winnipeg	Manitoba	Scarlet	73	0
1920	Regina	Saskatchewan	Typhoid	83	9
1921	Montreal	Quebec	Typhoid	5	0
1921	Vinelands	Ontario	Typhoid	20	0
1922	Quebec City	Quebec	Typhoid	14	3
1922	Montreal	Quebec	Typhoid	33	3
1922	Winnipeg	Manitoba	Scarlet	29	0
1922	Winnipeg	Manitoba	Scarlet	10	0
1923	St. John	New Brunswick	Typhoid	10	0
1923	Sherbrooke	Quebec	Typhoid	7	2
1923	Arnprior	Ontario	Typhoid	6	0
1923	Hanover	Ontario	Typhoid	46	4
1924	Montreal	Quebec	Typhoid	16	2
1924	Quebec City	Quebec	Typhoid	8	0
1924	Quebec City	Quebec	Paratyphoid	5	0
1925	Winnipeg	Manitoba	Scarlet	28	0
1925	Winnipeg	Manitoba	Typhoid	9	2
1926	Winnipeg	Manitoba	Typhoid	15	0
1927	Montreal	Quebec	Typhoid	5002	533
1927	Chatham	Ontario	Typhoid	109	7
1927	Quebec City	Quebec	Typhoid	12	0
1928	Quebec City	Quebec	Typhoid	20	4
1928	Dundas	Ontario	Typhoid	13	0
1928	Timmins	Ontario	Typhoid	10	0
1928	Sturgeon Falls	Ontario	Typhoid	12	0
1929	Edmonton	Alberta	Scarlet	28	0
1929	Ameliasburg	Ontario	Typhoid	17	2
1930	Belleville	Ontario	Typhoid	18	3
1930	Kirkland Lake	Ontario	Septic Sore Throat	457	4
1930	S. Westminster	British Columbia	Typhoid	14	1
1930	Montreal	Quebec	Typhoid	130	26
1930	Montreal	Quebec	Typhoid	96	12
1931	Kitchener	Ontario	Scarlet	11	0
1931	St. Catharines	Ontario	Paratyphoid	487	3
1931	Surrey	British Columbia	Typhoid	14	1
1931	Hampton	New Brunswick	Typhoid	7	0
1931	La Pérade	Quebec	Typhoid	29	2
1931	Dauphin	Manitoba	Septic Sore Throat	100	0
1932	St. Maurice Val.	Quebec	Typhoid	527	45
1933	St. Catharines	Ontario	Paratyphoid	30	0
1933	Carman	Manitoba	Typhoid	15	1
1933	Port Elgin	Ontario	Septic Sore Throat	27	0
1933	Kingston	Ontario	Typhoid	19	0
	Total			7812	681

EPIDEMICS ACCORDING TO DIAGNOSIS

	Epidemics	Cases	Deaths
Typhoid	35	6514	674
Paratyphoid	3	522	3
Scarlet	7	192	0
Septic Sore Throat	3	584	4
	48	7812	681

The writer wishes to express his appreciation of the courtesy and co-operation extended by the provincial health authorities and the city medical health officers who have provided the information given above.

The Nutritional Value of Pasteurized Milk

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IN recent years growing enthusiasm among nutrition workers to encourage greater use of milk by both children and adults has resulted in increased consumption of this food. Simultaneously there has been extension of pasteurization as a safeguard for the population against milk-borne diseases. From the beginning of the twentieth century to 1932 the percentage of milk pasteurized in cities of 10,000 population and over in the United States had increased from a negligible figure to 87.5 per cent.[1] Consequently it is desirable to examine existing evidence regarding the effects of pasteurization on the food value of milk.

The advocacy of increased milk consumption is due to the fact that milk supplies several valuable dietary constituents. Primarily it is our best source of calcium. On the average, cows' milk contains 175 mg. calcium oxide per 100g. compared with 38 in human milk[2]. It is also a good source of phosphorus. It contains a complete, grade A protein, casein. It provides us with vitamin A in large amounts. In fact, McCollum[3] has stated that the fat of milk is the most important source of vitamin A in American and European diets. In addition, milk contains small amounts of vitamins B_1, B_2, C and D.

Despite the fact that milk is a valuable, perhaps the most important, article of diet, it should be remembered that it is not a perfect food. A diet of milk alone will not sustain life for more than a few months. The iron content is extremely low. A customary procedure for the production of experimental nutritional anaemia is to maintain rats on a high milk diet. Infants are saved from anaemia by a storage of iron in the liver at birth. The vitamin value of milk varies greatly, being influenced by the fodder of the cow. The amount of vitamin A is highest when the cow is on green pasture[4]. Milk is not a satisfactory source, at any time, of the other vitamins. If scurvy in guinea pigs is to be prevented by milk alone a quantity must be consumed which practically amounts to a full milk diet.[5, 6] Even the small amount of vitamin C in milk varies appreciably, one investigator having found that 20 cc. of summer milk equals 60 cc. of winter milk.[7] It is essential, then, that an infant receive a supplement containing the antiscorbutic vitamin.

Numerous investigations have been made to determine the changes produced in milk by pasteurization. The value of many of the reports has been lessened because the work was sponsored by interested parties (groups opposed to pasteurization or in favour of it, or manufacturers having special pasteurizing equipment for sale). In reviewing the literature one is impressed by the wide discordance in results and it is difficult to reach a definite conclusion. Here an attempt has been made to discuss only such results as

are pertinent to the title and which appear to have been obtained by impartial investigators.

Pasteurization causes two types of changes in milk: those due to heat alone and those resulting from oxidation, which is also accelerated by increased temperature. Frequently the suggestion has been made that milk proteins are affected. For example Isaachsen[8] claimed that the reduced food value of milk after pasteurization which he observed in infants was due to denaturization of protein. Previously, however, Courtney[9] had shown that there was no significant difference in the character of the curd formed by raw and by pasteurized milks.

It is a well known fact that when milk is heated, particularly to boiling, a precipitate is formed which contains considerable calcium. In pasteurizing equipment "milk stones" occasionally form. The composition of these is variable but calcium is an important constituent. Various estimates have been made as to the actual loss in calcium. Courtney[9] found no discernible difference. Mattick and Hallet[10] observed a two per cent loss in diffusible calcium. The poor growth in rats fed pasteurized milk in the frequently quoted experiments of Daniels et al[11] was attributed to loss of calcium. Unfavourable calcium retention from pasteurized milk has been found in young pigs by Magee and Harvey,[12] and in adult humans by Kramer et al.[13] On the other hand, favourable calcium retention from pasteurized milk was observed in rats by Brenner[14], and by Krauss, Erb and Washburn.[15] As cows' milk is such an excellent source of calcium, one would expect a positive calcium balance when adequate amounts are fed, unless the losses during pasteurization are severe. It is certain that some decrease does occur and any improvements in pasteurization tending to minimize the loss would be advantageous. Tuckey[16] has pointed out that the precipitation of calcium may be lessened by using hot water in place of steam, thus preventing excessive local heating.

Observations by Hess[17] on children in a New York hospital first attracted attention to changes in the vitamin content of milk produced by pasteurization. He found that scurvy developed in children consuming pasteurized milk without an antiscorbutic supplement. Similar results have been reported by Miller[18] and by Chick and associates[19]. Studies on guinea pigs have shown losses in vitamin C ranging from 20 to 90 per cent, depending on the method of pasteurization.[20] A recent study by Muira places pasteurized milk between raw and autoclaved milk in antiscorbutic value. It should be remembered, however, that cows' milk is a poor and variable source of vitamin C.

Fortunately the vitamin most abundantly contained in milk, A, is heat-stable and is unaffected by pasteurization. Several investigators have shown a slight loss to occur in the concentration of vitamins B_1 and B_2. Daniels, Giddings and Jordan[21] found that the open method of pasteurization caused a slight loss in B_2, while no decrease was noted in milk pasteurized in a closed system. Samuels and Koch[22] observed that all samples of raw milk which they examined were low in B_1 and that commercial pasteurization caused a destruction ranging from one-fifth to one-sixth. These workers found no

change in B_2. Mattick and Golding[23] also noted a diminution in B_1 after pasteurization.

Several feeding experiments have been conducted to determine the general nutritional value of pasteurized milk. Reference has already been made to the work of Mattick and Golding[23]. This investigation, carried out in the National Institute of Dairying at Reading, has been used as a strong argument against pasteurization. As interpreted by the authors, the results are such as would discourage the use of pasteurized milk but unfortunately the experiments were carried out on a very few animals and, in the reviewer's opinion, are insufficient to permit any general conclusion. Moreover, experiments much more thoroughly controlled by Krauss and associates[15] were carried out on paired rats in glass cages. Practically identical results were secured with raw and pasteurized milk. Both groups had equally good bone structure and there was no significant difference in growth curves.

Useful as are animal experiments in nutrition, the final crucial test is that on humans. Corry Mann has reported two extended series of observations on children. In the first study[24] various supplements were given school boys and, of those tried, one pint per day of pasteurized milk was found to be most effective as judged by rate of growth. Mann[25] has also reported studies on infants in the Evelina Hospital for Children in London, from which he drew two conclusions: (1) milk pasteurized by the low temperature holding process (145° F. for 30 minutes) is not damaged as food for infants; (2) no incidence of scurvy was observed over a period of three years in children under two years of age given pasteurized milk *without* orange juice. In another group no increase in growth rate and no improvement in nutrition resulted from an addition of orange juice. Since raw milk itself is a poor source of vitamin C and since authentic evidence indicates a loss during pasteurization, this second conclusion seems unduly optimistic.

A most thorough and reliable study of the effects of pasteurized milk on the growth of children was published last year by the United States Public Health Service.[1] Two groups aged from 10 months to 6 years were investigated, 1,807 having received raw milk and 1,886 pasteurized milk with similar supplementary diets in both cases. There was no significant difference between the average weights and heights of the two groups. The authors stated that the results demonstrated that the growth-promoting capacity of pasteurized milk was not measurably less than that of raw milk. It is interesting to note that the incidence of intestinal disturbances was 196 per 1,000 in the raw milk group and 111 per 1,000 in the pasteurized milk group.

SUMMARY

Milk is a valuable dietary constituent because it supplies high quality protein, calcium and vitamin A. Of these, only one, calcium, is affected by pasteurization. It is desirable that the depreciation in calcium content be minimized as much as possible by the prevention of local over-heating. Pasteurization lessens the amount of vitamin C, but raw milk is a poor and

variable antiscorbutic and artificially fed infants should always receive a supplement containing vitamin C. Careful observations on large groups of children have shown that growth is as satisfactory with pasteurized as with raw milk.

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Model Milk By-Laws

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LOCAL by-laws are commonly employed to secure control of milk supplies in the individual municipalities. While conditions vary a great deal in these places and different methods prevail, there are certain features in connection with these by-laws which are somewhat uniform and desirable for incorporation in any such enactments. Health officials need to be familiar with this material and the drafting of it into a by-law.

Most milk legislation in operation in Canada and elsewhere consists of legislative control by the state and supplementary control by local authority.

It is seldom that a state milk by-law can be sufficiently detailed to meet the many different local needs. In Canada there is no federal legislation which plays any major part in this field. The provinces, however, have varied legislative enactments, with a tendency to define certain minimum standards, and to pass on to the local municipalities much authority and certain responsibilities in milk control. It would seem highly desirable that any state or provincial legislation should be fortified by local by-laws. Such by-laws are also desirable to bring uniformity to the requirements for any defined area and to enable the milk inspector to maintain contact and supervision over those engaged in milk handling. Most milk control is of an educational nature, but in order to bring into line those who refuse to be aided some legislative authority is always necessary.

A common type of provincial milk legislation contains definitions and certain minimum standards for milk constituents. This legislation generally deals with matters which are common to all places and authorizes the local centres to adopt amendments, subject to provincial approval. Authority to appoint their own milk inspectors and to set standards varying from the provincial standards is given to the municipalities.

Local milk by-laws should serve two main functions: firstly, they act as an informative guide to dairymen in that they specify the requirements of the municipality for which they are adopted; and, secondly, they serve as a check against those who would set up their own standards. The value of any by-law, however, rests chiefly in the manner in which the inspector enforces the requirements.

Milk by-laws contain clauses dealing with many matters. In the preparation of these by-laws it must be kept in mind that some things cannot be enforced, and in this case it is useless to include them. All clauses in these by-laws should be reasonable for the dairyman and assure the necessary protection for the consumer. They should be specific and clearly set forth what the dairyman is to do. If the clauses are feasible and a co-operative attitude is displayed by the inspector, greater regard for all demands will be manifest. Some of the main points in these by-laws are as follows:

(1) *Licensing.*—In order better to exercise control and supervision over the production and distribution of milk, it is desirable to issue licences. These should be issued at a nominal fee and no attempt made to convert this into a money-making proposition. In some centres only the distributors are licensed, while in others the producer is also included. The latter policy is desirable in that it gives more complete control and protects against the common complaint of "bootleg" milk being sold. The distributor should notify the licensing authority and list all milk producers supplying his plant. Purchasing from unlicensed producers should invoke a penalty.

(2) *Appointment of Inspectors.*—The inspectors should be definitely named in the by-law, or in a supplementary by-law. In this connection, it is desirable to have provincial legislation which automatically makes the medical officer of health a milk inspector under any by-law.

(3) *Treatment of the milk.*—Any local by-law should clearly define the

standards and degree of treatment for milk. Pasteurization of the entire milk supply comes within this scope. Definite specifications should be set out for pasteurization and the installation of equipment, and the methods to be employed in the operation. All of these should be subject to approval by the milk inspector and the medical officer of health.

(4) *Production.*—The procedure to be followed in the production and handling of milk should be defined in the by-law. Adequate cleaning of the cows, the stable and all equipment used is important. Rapid cooling of the milk should be insisted upon. A temperature of 50° F. or lower is a reasonable requirement. The provision of a separate milk house for every dairy farm is highly essential, and this should be used not only for the storage of the milk, but for the washing of the utensils as well.

(5) *Processing.*—Requirements for the handling of milk in the dairy, the general equipment to be used, the cleansing and similar features of importance should be fully set out for the guidance of the distributor.

(6) *Quality of the final product.*—The product delivered by any dairy is the best indication of its efficiency. To state in a by-law that milk shall not contain more than a specific number of bacteria is difficult of compliance, except where milk must meet a very high standard and is exceptionally well supervised. Some definite figures for bacterial counts may well be adopted as a standard, but it would seem more desirable to incorporate these as a set of instructions which would accompany the by-law rather than become a part of it.

There are various other clauses which may be included in milk by-laws, but the municipality for which it is to be adopted should take cognizance of its own particular requirements, and so modify any model by-law as to take care of these. Most of these by-laws require authorization by some central authority before they become effective.

In view of the difficulty of stating specifically in a by-law all that is expected of a dairyman, it would seem well to prepare a set of instructions for both the producer and the distributor. In these a number of items might be discussed to advantage and particularly where optional methods are satisfactory. The cleaning of equipment, disinfection of pipe lines, and objectives for the final product are all matters which need consideration. It has been customary in a number of places to adopt bacterial counts of 50,000 per cc. for raw milk, and 10,000 per cc. for pasteurized milk. These standards might well be included in the set of instructions, and if they are not met the inspector should endeavour to assist the dairyman in determining the cause. Continued violation of these standards would merit the discontinuance of the licence for a short period or indefinitely.

It is desirable that model by-laws should be prepared by the central provincial authority for use by their municipalities. This serves as a good starting point and requires modification only sufficient to meet local needs.

The Public and Pasteurization

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IT is a generally accepted principle that education should precede legislation and that opposition to any health measure should be forestalled by giving the public all the facts. But there are various ways of giving information and, from the writer's experience, public meetings, open for discussion, are not the best. It is doubtful if a public meeting should be included as part of the educational propaganda for the pasteurization of milk. The number of people who attend such a meeting is very limited; the majority are present because they have personal interests at stake and the true facts do not reach the bulk of the people. A professional "anti" is readily obtained who can hold the floor for the evening and carry the meeting. When a meeting of so-called ratepayers has thus expressed itself as opposed to pasteurization it is difficult for a council, even if in favour, to carry a by-law requiring pasteurization or to enforce rigidly one already existing. The writer can recall many such instances, of which the following story is typical.

Some years ago the medical health officer of one of our Western cities saw in a typhoid epidemic in a city college an opportune time for the reintroduction of a by-law for the compulsory pasteurization of all milk sold in the city. For years he had been advocating such a step, but successive councils had failed to take action. The governors of the college in which the outbreak occurred had thought that by providing raw milk direct from the farm they would be giving the resident students a better quality of milk than that purchased by the citizens at large from city pasteurizing plants. A milk-borne epidemic of typhoid fever among the resident students resulted in 83 cases and 9 deaths.

The council, before considering the by-law, decided to discuss the question at a public meeting to which they invited all officials and individuals interested in the city milk supply. Amongst those who spoke was the principal of the college which had lost nine young men and women through the epidemic. He made a most eloquent appeal to the council to pass a compulsory pasteurization by-law and told in plain words of the fatal experience into which the governors of the college had been led through lack of knowledge of the dangers of raw milk. But the council chamber was crowded with raw milk vendors and their supporters, the municipal elections were approaching, and when the vote was taken in council a few days later the proposed compulsory pasteurization by-law was again defeated.

In another city, when similar legislation was introduced, the council were advised by their medical health officer that a pasteurization by-law was necessary to protect the public health. No public meetings were held but

the council acted on the expert advice given them and passed the by-law with a minimum of discussion. As a result, the citizens have enjoyed complete protection from milk-borne epidemics for the last ten years.

The general financial situation at the present time has added to the difficulty of obtaining pasteurization legislation and of enforcing it. Where equipment has become defective or obsolete, or has been destroyed by fire, the authorities hesitate at times to enforce regulations rigidly. A type of citizen uses the depression as an excuse for evasion. As an example of the ingenious methods which may be used to evade the law, the following incident is of interest.

An individual intent on disposing of raw milk in a city "where no milk shall be sold, offered for sale or deposited for sale unless it has been pasteurized" entered into a contract with some thirty customers whereby he undertook to sell them one-tenth interest in a cow for $5.00. Under the contract he supplied the customer with one quart of milk per day. The customer paid seventy cents per week for delivery of the milk, including his contribution towards the cost of feeding and caring for the cow. It was thus claimed that the milk was not being "sold" and that there was no infraction of the law. The Public Health Act, the Provincial Milk Regulations and the city by-law have had to be amended frequently during the last few years to cover just such cases.

The best support a pasteurization by-law can have is a satisfactory product and a satisfied public. No arrangement which does not safeguard the quality of the milk and its palatability should be considered, as a poor product invariably jeopardizes the by-law. In the vast majority of instances there is a satisfactory solution to the problem, if it is found before the by-law is wrecked. The following incident exemplifies this.

A town of 1,100 people adopted compulsory pasteurization this year. Tests made on the herds in the district surrounding the town showed that a large number of cows producing milk were infected with contagious abortion and the town council, having obtained advice as to how the citizens could be protected against undulant fever, decided to require all milk sold in the town to be pasteurized.

Two dairymen were supplying the bulk of the milk to the citizens and an arrangement was first made with the local branch of the creamery company to receive the milk from these dairymen, pasteurize it and return it to them. The creamery company, however, assumed no responsibility for the temperature of the milk on delivery nor for the efficiency of the process of pasteurization. They were treating the milk merely as an accommodation to the town in order to permit of the by-law becoming effective.

The arrangement was soon found to be unsatisfactory as the town authorities had no control over the equipment and methods used in pasteurization and, further, the milk, after being pasteurized, was not bottled by the creamery company but was collected in cans by the producers, taken back to their premises, bottled and delivered to the consumer on the following morning. Insufficient facilities for keeping the milk cool over night resulted in numerous complaints being made by the consumers as to the quality of the milk. This was naturally attributed to the process of pasteurization and it looked as if the enforcement of the by-law would have to be abandoned.

One of the producers, however, undertook to install his own pasteurizing

equipment and purchased a fifty gallon pasteurizing vat fitted with chart and recording thermometer. The milk was transferred after pasteurization to a water jacket cooler where it was reduced to a temperature of 45° F. and filled into sterilized bottles by an approved bottle filler. The bottles were capped by machinery and placed in cold storage until delivered to the consumer. The entire equipment was of the simplest possible form and cost less than a thousand dollars, but it was operated intelligently and the charts showing the time and the temperature of pasteurization were filed daily for inspection by town officials.

A factor in the defeat of pasteurizing by-laws in municipalities is the use of the unfortunate word "compulsory". Human nature is such that it rebels against any suggestion of coercion, and if another word could be found to qualify pasteurization of milk as applied to the entire community, the measure would be less likely to meet with opposition on the part of the public.

It was Ruskin who said:

"Let a child fall into the river before the roughest man's eyes, he will usually do what he can to get it out, even at some risk to himself. And all the town will triumph in the saving of one little life. Let the same man be shown that hundreds of children are dying of fever for want of some sanitary measure which it will cost him trouble to urge, and he will make no effort: and probably all the town would resist him if he did."

These words may, in the light of prophylactic measures in force to-day, seem rather pessimistic, but the public will always be more interested in the spectacular eleventh-hour saving of life than in the quietly calculated up-hill work of disease prevention.

The Extent of Pasteurization in Canada

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THE extent to which tuberculin testing and pasteurization are used by 24 of the larger cities of Canada is shown in the accompanying table. In 19 of the 24 cities from which the completed questionnaire was received, 60 per cent of the milk sold is pasteurized; in 5, 100 per cent is pasteurized. In all, some start has been made in pasteurization.

INFORMATION REGARDING PASTEURIZATION AND TUBERCULIN TESTING IN 24 OF THE LARGEST CITIES OF CANADA

City	Province	Population at 1931 census	Year pasteurization by-law passed	Percentage of milk pasteurized	No of pasteurizing plants	Percentage of dairy cows T.B. tested
Montreal	Que.	810,925	....	95%	35	100%
Toronto	Ont.	627,582	1914	100%	55	60%
Vancouver	B.C.	245,307	....	89%	20	100%
Winnipeg	Man.	217,587	....	74%	9	51%
Hamilton	Ont.	154,914	1928	100%	20	98%
Quebec	Que.	129,103	....	40%	5	100%
Ottawa	Ont.	124,988	....	98%	18	100%
Calgary	Alta.	83,362	....	80%	3	100%
Edmonton	Alta.	78,829	....	75%	5	100%
London	Ont.	71,022	....	81%	16	15%
Windsor	Ont.	62,957	1926	100%	10	5%
Halifax	N.S.	58,939	....	85%	8	80%
Regina	Sask.	53,034	....	96%	7	100%
St. John	N.B.	46,640	....	90%	6	100%
Saskatoon	Sask.	43,025	1923	100%	4	100%
Victoria	B.C.	38,441	....	33%	4	100%
Three Rivers	Que.	35,197	....	57%	3	100%
Kitchener	Ont.	30,261	....	95%	11	55%
Brantford	Ont.	30,060	....	97%	7	55%
Sherbrooke	Que.	28,888	....	25%	1	100%
Ft. William	Ont.	26,075	....	88%	5	1%
St. Catharines	Ont.	24,703	1929	100%	9	8%
Kingston	Ont.	23,204	....	64%	4	20%
Sydney	N.S.	22,319	....	8%	2	5%
Total		3,067,362		Average 78%	Tot. 267	Av. 69%

It is striking that but 25 municipalities in Canada, according to available data, require all milk sold to be pasteurized. The by-law in Kirkland Lake was passed following the epidemic of septic sore throat in 1930. Other municipalities might well adopt similar restrictions before rather than after a similar experience.

MUNICIPALITIES IN CANADA WHICH HAVE PASSED BY-LAWS REQUIRING ALL MILK SOLD TO BE PASTEURIZED

St. Lambert, Que.
Lachine, Que.
Toronto, Ont.
Hamilton, Ont.
Windsor, Ont.
St. Catharines, Ont.
Carleton Place, Ont.
East Windsor, Ont.
North Bay, Ont.
Sudbury, Ont.
Timmins, Ont.
Kapuskasing, Ont.
Walkerville, Ont.
Whitby, Ont.
Sandwich, Ont.
Forest, Ont.
Barrie, Ont.
Iroquois, Ont.
Iroquois Falls, Ont.
Kirkland Lake, Ont.
Leamington, Ont.
Richmond Hill, Ont.
Saskatoon, Sask.
Moosomin, Sask.
Kerrobert, Sask.

Clean Bottles, A Factor in Clean Milk*

A PRELIMINARY REPORT

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WE desire, at this time, to make a preliminary report of some investigations, covering the past year, regarding the importance of the factor of bottle washing in producing a milk bacteriologically safe and acceptable for public consumption. Our attention was drawn to this question while trying to solve the difficulties of some of our dairies which were experiencing difficulty in reducing the bacterial counts of their milk to a satisfactory level. I wish here to state that the dairies under the jurisdiction of the Department of Health of the City give full co-operation to us in our work of solving their bacteriological problems.

The safety of a milk supply is estimated largely by qualitative and quantitative examinations of samples of the milk in the form in which it is delivered to the consumer. If the sample, as it comes from the delivery wagon, has a satisfactory bacterial count and is free from pathogenic organisms, such as tubercle bacilli, streptococci, and colon bacilli, the latter of which suggests stable contamination, inefficient pasteurization or bottle contamination, or perhaps all three, the milk is considered safe for use in a bacteriological sense. But when these conditions do not obtain, a thorough investigation of all stages, from the raw milk stage to the bottle stage, becomes necessary. Attention is usually first directed to the pasteurizing apparatus. The modern pasteurizing apparatus, if free from defects, properly installed, kept clean and provided with automatic temperature recording apparatus, does not often go wrong when operated under skilled supervision, so that in such cases attention has to be directed to the state of the raw milk and, what is probably much more important, to the state of the container into which the pasteurized product goes.

Our Department of Health sets a bacterial count of 50,000 per cc. as a standard, making some allowance for the hot summer months. Pasteurization is compulsory. In searching for a cause for high counts in the case of one dairy, we were unable to find the pasteurization at fault. The raw milk had not an unduly high count. We then turned our attention to the bottle washing and made bacteriological studies of the washed bottles and of the washing machine itself. We found, according to the technique to be presently described, that an average of ten bottles examined on one occasion gave a count of 9,800 per bottle, and on another occasion a considerably higher figure of nearly 100,000 per bottle. The water in the washing machine gave high counts as well. We came to the conclusion that the trouble in this case

arose from a lack of efficiency in the washing machine, and suggested a closer check on the concentration of the chemical, the regulation of the temperature and of the time of exposure of the bottle. The difficulty disappeared.

The technique employed was as follows. Ten bottles were taken at random from the line just before they were to be filled with milk. They were capped and taken to the laboratory and kept in the refrigerator until cultured. (Cultures were made always within one or two hours.) Into each one, 100 cc. sterile distilled water was measured and the bottle thoroughly agitated. One cc. of this water was then plated in agar and incubated for 48 hours. Quantities of 1 cc. and 10 cc. were placed in McConkey's liquid medium (neutral red, bile salt lactose), and incubated for 48 hours to show gas production; 1 cc. was inoculated into glucose broth, incubated 48 hours, the culture centrifuged and the sediment stained to show streptococci if present. The number of colonies on the plate multiplied by 100 gave us a measure of the total bacterial content of the bottle. This figure, of course, will not be absolute, but we feel that by applying the same technique in all cases, relative and comparative results are to be obtained.

As a routine, we make a bacterial examination once a week of each dairy in the city. We thought that a periodic examination of bottles as they came from the washer would be of considerable assistance to the dairy in discovering any inefficiency there, and for the past twelve months we have been carrying this out about four times a year for each dairy and on any special occasion when it has seemed necessary. We have on rare occasions found colon bacilli and streptococci in bottles. The following tables show a few of the results obtained, and provide a comparison of the bottle counts with counts of the milk collected the same day or the day after. In all, twenty dairies were studied, with a total of 600 bottle examinations.

Most bottle washing machines, as has been said, employ three factors to secure a relatively clean bottle. Practically all use some chemical, more as an agent for removing fat than as an antiseptic. The efficiency of this chemical depends on its being kept at proper concentration, and, of course, this concentration gradually decreases with use. Then there is the factor of temperature which can not be made too high with safety to the bottle. What is still more important is the time factor. Hurrying the process nullifies the efficacy of the two previous factors. All three factors must be kept in mind by the dairy if its bottle washing is to be efficient. The ideal bottle in which to place the pasteurized milk would be a sterile bottle, but unfortunately considerations of expense make that, we fear, impracticable.

We may summarize our conclusions as follows:

1. Efficient pasteurization may be rendered of no avail if the pasteurized milk is placed in bottles which are bacteriologically unclean. In the warm months, counts from such bottles are likely to be unwarrantably high and the milk is apt to sour early.

2. The ideal bottle to receive the milk would be a sterile bottle. This is impracticable, so that a relatively high degree of bacteriological cleanliness must be maintained.

3. From our observations we feel that the total count per bottle, estimated according to the technique described, should not exceed 100, or at most 200, per bottle. Colon bacilli or pathogens should not be found.

4. The periodic bacteriological investigation of the efficiency of the bottle washing is a valuable aid to the dairies in providing a product bacteriologically satisfactory.

RESULTS OF BACTERIOLOGICAL EXAMINATIONS OF BOTTLES AND OF MILK

Dairy and Dates of Examination		Bottles			Average 37° count of Unsterile Bottles	Presence of		Milk 37° count
		No. examined	Sterile	Unsterile		B. Coli	Streptococcus	
DAIRY A	15. 9.32	2	0	2	9,850	0	0	250,000
	21. 9.32	2	0	2	450	0	0	87,000
	4.10.32	1	1	0	0	0	0	18,000
	21.10.32	2	0	2	100,000	0	0	225,000
	21.11.32	5	3	2	300	1	0	375,000
DAIRY B	28. 9.32	2	0	2	350	0	0	275,000
	4.10.32	1	0	1	100	0	0	47,000
	18.10.32	1	0	1	1,000	0	0	350,000
	27.10.32	1	1	0	0	0	0	3,000
	7.12.32	10	7	3	100	0	0	5,000
	30. 6.33	10	3	7	157	1	0	30,000
	8.11.33	5	2	3	400	0	0	15,000
Dairy C	4.10.32	1	1	0	0	0	0	45,000
	23.12.32	10	10	0	0	0	0	2,000
	12.10.33	10	10	0	0	0	0	8,000
	8.11.33	5	3	2	150	0	0	18,000
	7.12.33	5	2	3	200	0	0	8,000
DAIRY D	4.10.32	1	1	0	0	0	0	8,000
	3.11.32	1	0	1	1,000	0	0	50,000
	6.12.32	10	10	0	0	0	0	4,000
	30. 6.33	10	4	6	2,166	0	0	100,000
	19.10.33	10	5	5	140	0	0	18,000
	8.11.33	5	3	2	300	0	0	29,000

Clean Milk and Safe Milk

It must be noted that a clean milk is not by any means necessarily a safe milk. Milk obtained from a herd infected with tuberculosis or contagious abortion is never safe, no matter how cleanly it may be produced. Cleanliness of the general milk supply is desirable but cleanliness is not enough. To ensure its safety, that is to say, its freedom from pathogenic organisms, pasteurization is essential.—*J. M. Hamill, THE LANCET, Dec. 30, 1933.*

Sanitary Caps for Milk Bottles

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IN the handling and processing of milk elaborate precautions are taken to ensure that all active disease producing organisms have been eliminated both by safeguarding the raw product or through treatment by pasteurization. After pasteurization it is essential that the milk be completely protected from contamination until it reaches the consumer. For this reason special equipment is employed for cooling and bottling which is designed to reduce this possibility to the minimum. The milk is placed in clean glass bottles and the caps are applied mechanically. This affords protection until delivery to the consumer. Since cleanliness and safety are essential, not only when the milk is in the container, but primarily when it is consumed, consideration must be given to the removal from the bottle.

Milk bottle caps vary in design and in the purpose they serve. Most of them are made of paper, but others are also employed, chiefly of aluminium or some light and easily worked metal. The standard cap is employed chiefly to prevent the milk from getting out of the bottle. In order to make the capping of the bottle possible by mechanical means a groove is formed in the top. The cap is accordingly at a lower level than the top of the bottle. The standard cap does not extend over the lip or pouring surface. This means that the householder must thoroughly clean the top of the bottle before the milk is poured. While this may seem a reasonable request, it is inconvenient. In addition, much milk is consumed away from home and in places where it is not easy to have the top cleaned before the cap is removed. The result is that cleanliness is far from complete. The delivery man places his hand on the top of the bottle and an uncontrolled contact is established. Dust and dirt of various kinds may also be deposited. If this is not all removed before the cap is lifted, part of the work of processing the milk has been offset.

Adequate sanitary protection of the top of the milk bottle would seem to call for a cap which would cover the pouring lip. There are many types of caps which endeavour to fulfill this purpose. The technical journals contain descriptions of numerous caps designed to combine convenience, sanitation and sales appeal. Most of these, however, cost more than the standard cap and in competitive markets they are not used as extensively as might be desired. No doubt the maximum protection is afforded by that cap which covers the entire top of the bottle and extends some distance below it on the outside. This is generally used with the standard cap. Another type of cap covers only part of the top but is presumed to protect the pouring lip. It is more easily applied and does not require a second cap with it.

It would seem very desirable for milk distributors to consider seriously the use of these caps on their bottles. It is hoped, and there are signs in this direction, that methods can be developed which will reduce the cost to a low figure and make it possible to have more sanitary protection for these bottles.

Common Defects in Pasteurizing Plants*

INCLUDING

A Survey of Pasteuring Plants in a Large City

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THE Provincial Department of Health had occasion recently to conduct a survey of the milk situation in one of the larger cities. The object of this survey was primarily to determine the efficiencies of the various pasteurizing plants. Some consideration was also given to the raw milk supply and to related details connected with sanitary control of the product.

Legislation

In order better to grasp the situation with respect to milk control in urban centres it is well to be familiar with the legislation in this field. The Provincial legislation is contained in the "Milk and Cream Act" and the "Public Health Act." The former gives authority to the municipalities to pass their own milk by-laws, provided the by-laws are approved by the Minister of Agriculture. This legislation does not authorize the Provincial Health Department to inspect or to take any major part in the control of the dairies. The activities of the department have accordingly been confined to giving assistance to the local authorities, and in this respect a number of investigations have been made at different centres throughout the province. It has been possible to aid in the correction of mechanical defects as well as operating technique at these plants.

The "Milk and Cream Act" places full responsibility for the control of the dairies on the local officials. These by-laws are passed by the municipal council rather than the local board of health. This has been criticized, since it is necessary to convince the members of the council of the need for proper legislation to control milk supplies. The fact that councils change so frequently makes this problem all the more difficult. In the larger municipalities with well organized health departments it is quite feasible to give effect to local by-laws and carry on inspections of the plants. In the smaller centres this becomes a problem. The result is that the inspection service fails and the public does not receive the protection that it might expect.

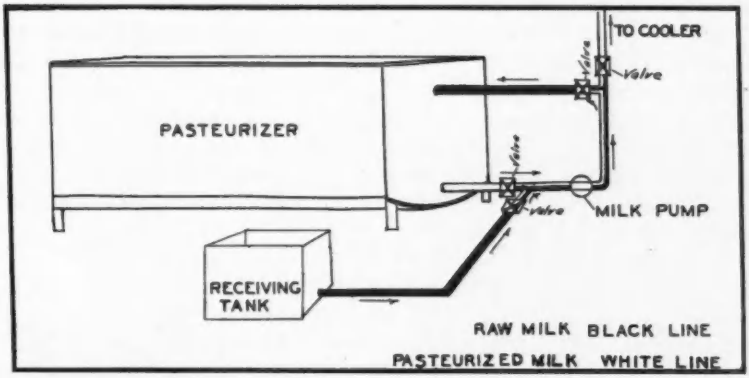
The Situation in this Survey

The city to which reference is made in this paper has an approximate population of 65,000, and may be taken as an average for the larger centres. There is a well organized board of health, and while the personnel is not large it probably corresponds fairly well with similar cities. There is a

*Presented at the Christmas Meeting of the Laboratory Section, Canadian Public Health Association, Toronto, December, 1933.

milk by-law in force. It was passed in recent years, and gives sufficient control for inspection by the local board of health under whose jurisdiction this work comes.

The by-law does not require pasteurization of all milk sold, but permits the sale of raw milk and cream, provided it comes from tuberculin tested cattle. There are a number of clauses in the by-law which are excellent, provided they can be enforced. The extent of adherence to these depends almost entirely upon the number of personnel available. Some 17 pasteurizing plants were in operation and all of these were examined during the investigation.



An example of faulty layout which permitted raw and pasteurized milk to flow through the same pipe line. A typhoid epidemic occurred on this dairy's milk route.

Tests Conducted at the Dairies

In this investigation the routine followed was to collect a number of samples at different points in the processing of the milk. Samples were also collected from the bottles and cans after rinsing with sterile water. By this means information was made available concerning the cleansing operations. The sampling points were so arranged to give an analysis of the different operations and the results of the different defects in the equipment. These samples were immediately submitted to the laboratory for bacterial plate counts, and the estimation of butter fat content. No attempt was made to sample all the milk coming from the individual producers.

The Raw Milk Supply

The milk supply is drawn from approximately 400 farms.

Before dealing with pasteurization it is well to have some knowledge of the raw product. It is obvious that a pasteurizing plant cannot be expected to deliver the best product unless the raw supply is satisfactory and contains no undue number of bacteria. The milk must also be clean.

In this city the entire inspection including the 400 farms and the dis-

tributing plants is allotted to one man. Not only has he to cover this field but he has a great many other duties as well. Thus it is quite impossible for him to do effective work. The local milk by-law requires that the milk reaching the dairies be below 55°F., unless it is delivered within three hours of the time of milking. Furthermore, the bacterial counts are not to exceed 50,000 per cc. in the raw supply. The samples were taken of the composite raw supplies in the various plants during reasonably cool weather when there is not the same tendency for high counts that there is during the summer months. This sampling does not give any indication as to maximum and minimum figures but it does show the general bacterial quality of the raw product. Of 56 samples examined only 3 gave counts below 100,000 bacteria per cc., and 10 of the 17 plants examined had raw milk with counts in excess of 1,000,000 per cc. These high counts may be attributed to the inadequacy of cooling of the milk on the farm and the way in which it is handled before reaching the plant, together with inadequate cleansing of the producers' cans at the dairies. The cans are returned in a wet condition and it would seem from the counts which were taken that this may be a prolific source of bacteria in the milk. These conditions in the raw supply do not tend to make the final product an ideal one. It, of course, can be made safe against the spread of milk-borne diseases.

Pasteurizing Plants

In the 17 pasteurizing plants it was found that a great variety of equipment was in use. Some of it was very simple while others were most elaborate and modern in all respects. In some plants it was found that conditions existed, both with respect to operation and to design of the equipment, which created potential danger to the supply. The bacterial counts on the finished product taken from the bottles were for the most part reasonably low, but in interpreting these results it must be borne in mind that counts alone do not portray an accurate picture as to safety. Where mechanical defects are present it is quite possible for some improperly pasteurized milk to gain access to the finished product and to endanger its safety. Operating methods may bring about similar results.

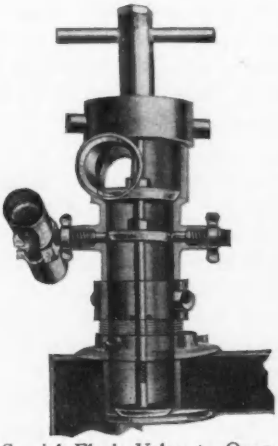
Mechanical Defects in Equipment

Mechanical defects were quite numerous. These may be considered under a number of different classifications.

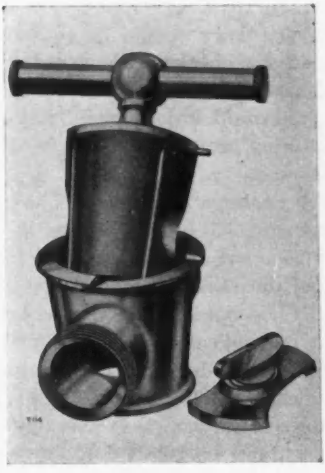
(a) *Cold Pockets.*—It was quite common in these plants to find cold pockets on the outlets from the pasteurizers. Over 70 per cent of the plants were defective in this respect. These pockets may permit milk to pass through the pasteurizer without being properly heated. A distinct menace exists under these conditions in that the first milk from the vat may contain dangerous organisms and these will contaminate the cooling equipment and this in turn infect the remainder of the milk. It is not reasonable to expect to get rid of this danger by drawing off the first part of the milk, as is the practice of some operators. In connection with cold pockets, consideration must also be given to the outlet valves. Some plants have valves which

are entirely unsatisfactory. Valves are of many types. Some of them are plain plugs with metal face to face. In these it is extremely difficult to prevent leakage, and if this occurs there is the possibility of inadequately treated milk gaining access to the finished product. Plug valves should be grooved so that leakage will go to waste. Another type of valve is sometimes found. It is a flush valve, but without any leak protector. This valve may eliminate cold pockets but it is not safe to use. Special outlet valves for eliminating cold pockets and leakage are available on the market and these should be utilized on all pasteurizing plants.

(b) *Inlet Piping and Valves.*—Defective inlet valves are less common and occur only where a number of pasteurizing units are attached to a common piping system. Only one of these was found in this survey. Special valves are available for protection against the possibility of raw milk reaching the processed product in the vat.



Special Flush Valve to Overcome Cold Pockets



Satistfactory Type of Inlet Valve

(c) *Piping Systems.*—In large milk plants complicated piping becomes necessary for carrying the milk from the different units. It is customary to connect a number of units containing both raw and pasteurized milk to a common pipe line. Unless special valves are employed it is a dangerous practice. These valves must be designed against leakage, and great care must be used on the part of the operator to see that the correct valve is operated and no raw milk is allowed to contaminate the finished product. Cross-connections of this kind are always hazardous with careless personnel.

Piping systems should be so arranged that there is the minimum chance for mistakes being made. A good arrangement is to disconnect the pipes from the pasteurizer until the milk is ready for cooling. This avoids the mistake which permits raw and pasteurized milk to mix in the pipe line at the same time.

The piping also must be so arranged that the pasteurized milk does not go through the same route as the raw milk. In a number of plants it has been found that raw milk is first put through the pipe line, and later the pasteurized product follows this same course. While theoretically the pipe lines may be cleaned and disinfected, too much depends on the part of the operator to permit of any such arrangement. Similar conditions develop in plants from which both raw and pasteurized milks are sold. It has been found that sometimes a certain amount of raw milk is cooled and bottled ahead of the pasteurized milk. The equipment may not even be cleansed between these two operations. Here again is a chance for contamination and it becomes a dangerous practice to handle the two milks on the same cooling and bottling equipment.

(d) *Recording Thermometers.*—Recording thermometers are very useful equipment as a guide to the milk inspector. They are, however, subject to certain limitations and there is a tendency to get out of adjustment readily. In this survey 2 were found to be defective.

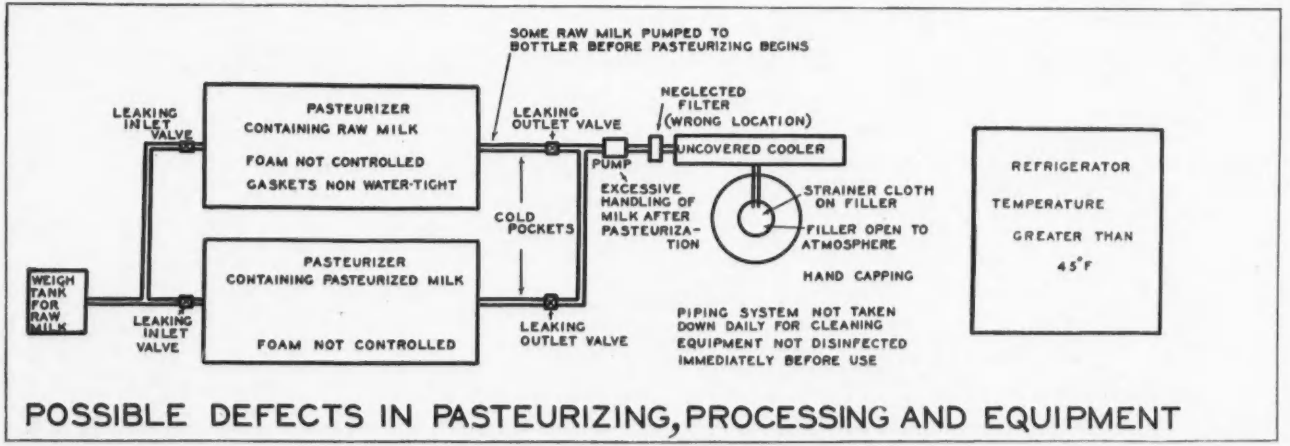
Every dairy should be equipped with an accurate hand thermometer to be used as a check on the recorder. Some dairies are equipped with recording thermometers in which the charts cover a period of a week. On such charts the gradations are so small that it is not feasible for the operator to make his reading accurately. The most suitable equipment is one with a 12-hour chart.

(e) *Cooling Equipment.*—The plants in the survey had a variety of cooling equipment. Complete cooling in the pasteurizer is practised to some extent but this is not an economical method. There is also some tendency in plants to cool the milk to about 90 or 100° F. before it goes to the surface cooler. This is objectionable in that it brings the milk within the range where bacterial multiplication can take place. In order to protect the cream line it is desirable to drop the temperature of the milk in the pasteurizer somewhat below the pasteurizing range but it should not fall below 120° F.

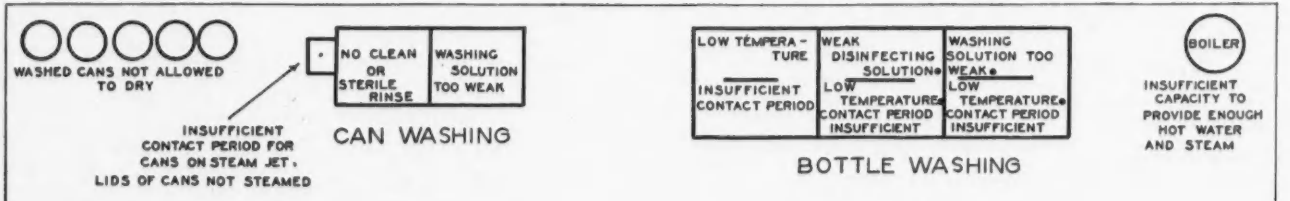
Uncovered cooling systems were found in nearly all the plants examined. They should be covered to prevent contamination of the treated product. This is only one of the measures necessary to prevent the possibility of contaminating the milk after it leaves the pasteurizer.

(f) *Bottling and Capping.*—This survey also revealed a number of methods for bottling and capping the milk. Mechanical cappers have come to be standard equipment in the modern dairy. Over 50 per cent of these plants, however, were using hand capping. This must always be regarded as a potential danger. If finances do not warrant the purchase of the usual mechanical equipment, small hand operated automatic cappers are available, and in these the fingers do not come in contact with the caps.

(g) *Plant Layouts.*—The survey indicates that the layout of equipment in the various plants is not always desirable. In many instances all processing and handling of the milk is carried on in one room. This is unsatisfactory, and every dairy should have at least two rooms for this work. An additional number is preferable, but two should be considered as the minimum.


SOME RAW MILK PUMPED TO BOTTLER BEFORE PASTEURIZING BEGINS
LEAKING INLET VALVE
PASTEURIZER CONTAINING RAW MILK
FOAM NOT CONTROLLED
GASKETS NON WATER-TIGHT
LEAKING OUTLET VALVE
NEGLECTED FILTER (WRONG LOCATION)
UNCOVERED COOLER
PUMP
EXCESSIVE HANDLING OF MILK AFTER PASTEURIZATION
COLD POCKETS
STRAINER CLOTH ON FILLER
FILLER OPEN TO ATMOSPHERE
HAND CAPPING
REFRIGERATOR TEMPERATURE GREATER THAN 45°F
WEIGH TANK FOR RAW MILK
LEAKING INLET VALVE
PASTEURIZER CONTAINING PASTEURIZED MILK
FOAM NOT CONTROLLED
LEAKING OUTLET VALVE
PIPING SYSTEM NOT TAKEN DOWN DAILY FOR CLEANING
EQUIPMENT NOT DISINFECTED IMMEDIATELY BEFORE USE

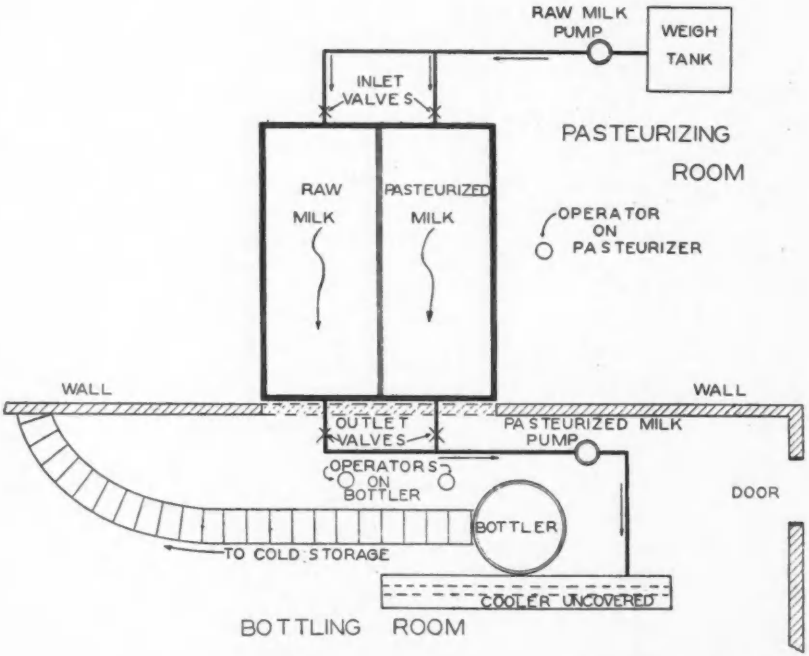
POSSIBLE DEFECTS IN PASTEURIZING, PROCESSING AND EQUIPMENT


WASHED CANS NOT ALLOWED TO DRY
NO CLEAN OR STERILE RINSE
WASHING SOLUTION TOO WEAK
INSUFFICIENT CONTACT PERIOD FOR CANS ON STEAM JET. LIDS OF CANS NOT STEAMED
CAN WASHING
LOW TEMPERATURE
INSUFFICIENT CONTACT PERIOD
WEAK DISINFECTING SOLUTION
LOW TEMPERATURE CONTACT PERIOD INSUFFICIENT
WASHING SOLUTION TOO WEAK
LOW TEMPERATURE CONTACT PERIOD INSUFFICIENT
BOTTLE WASHING
BOILER
INSUFFICIENT CAPACITY TO PROVIDE ENOUGH HOT WATER AND STEAM

POSSIBLE DEFECTS IN WASHING PROCESS

Operating Technique

Not only are equipment defects important but it is also essential that the operating procedure be such that safety and best results can be assured. In this survey the tests show that there is much to be desired in the operating. This is not entirely unexpected, since anyone may operate a pasteurizing plant whether he has had any training or not. A good deal of consideration has been given recently to the necessity for proper training of the operating personnel. This would seem to be a most desirable feature, if these unsatisfactory conditions are to be avoided.



LAYOUT OF A PLANT WHICH WAS FAULTY.—Inlet valves were improperly constructed. Outlet valves were neither leakproof nor flushproof and the piping layout was defective. A common outlet pipe from the two vats made an undesirable connection between the raw and the pasteurized milk. Any leakage from the raw milk valve would contaminate the treated product. The danger was further augmented by the possibility of the operator's opening the wrong valve. In the operation of the plant one tankful of milk was pasteurized and while this was being pumped to the cooler the other side was being filled and pasteurized.

Inefficient operation has been encountered in the cleaning of the utensils, piping and equipment which comes in contact with the milk. In many plants the first milk passing from the pasteurizer over the cooler and through the bottler contains a much higher bacterial count than that which follows later. As an example of this, one of the plants gave a count of 3,000 before

the milk left the pasteurizer. After cooling this had changed to 350,000. In another, the milk in passing from the pasteurizer to the bottler had jumped from 10,000 to 600,000 per cc. Bacterial counts are thus useful in determining the care that has been practised in the cleaning of the equipment. In plants where cleaning has been carried out properly there has been no significant increase in counts. There is also a tendency in some of the plants to avoid taking down the pumping and piping systems daily. All this equipment should be dissembled and thoroughly brushed and cleaned at the end of each day's operation. Only in this way can good results be expected.

A further source of inefficiency is noticed in the can and bottle washing. Sterile water rinsed in these utensils has shown very high bacterial counts. If a bottle is properly washed it need not contain more than a few hundred to a thousand bacteria. Some had as low as 50. In this survey some of the bottles gave counts in excess of 1,000,000, while counts in excess of one-half million were not uncommon. In the washing of cans even greater difficulties arise. Cans properly washed have shown counts of 50,000 and less. Some counts in these plants were in the billions, and counts in the millions were fairly common. It is not surprising under these conditions that the raw milk returned in these same cans will contain a very high bacterial content. This is not fair to the producer and unless he thoroughly washes and disinfects the cans himself the counts are likely to be high.

SUMMARY OF DEFECTS IN A SURVEY OF 17 PASTEURIZING PLANTS

MECHANICAL EQUIPMENT	NO. OF PLANTS
Wrong processing being followed	1
Defective inlets on pasteurizer	1
Defective outlets on pasteurizer	13
Cold pockets on pasteurizer	12
Defective piping	2
Filtering after pasteurizing	5
Inadequate cooling after pasteurizing	7
Uncovered coolers	14
Improper cooling in pasteurizer	2
Capping by hand	8
Inadequate screening	11
Bad plant layout	5

OPERATING METHODS	NO. OF PLANTS
Improper cleaning of piping	2
Ineffective steaming of cans	14
Lids of cans not steamed	4
Counts on cans too high	14
Ineffective steaming of bottles	8
Counts too high on bottles	9
Raw milk bottled before pasteurizing	1
BACTERIAL COUNTS	
Bottled milk with counts over 10,000	6
First milk over cooler—over 10,000	9
First milk through bottler—over 10,000	12

In summarizing the results of this survey it has been clearly shown that the plants have many mechanical defects and that the operating procedure is deficient in many ways. These conditions give rise to a situation in which the consumer cannot always feel that in the term "pasteurized" he is entirely protected against milk-borne diseases. There may be some answer in that where it is not compulsory to pasteurize all the milk it is not reasonable to expect these distributors to go to extra expense when they must compete against raw milk distributors. This is unfair competition, but any distributor who labels his milk as "pasteurized" should take every precaution to eliminate all danger to the consumer. The term "pasteurized" should always mean that the milk in that bottle is safe for human consumption.

Improper Pasteurization and Its Results

A. L. McKAY, B.A., M.B., D.P.H.

Director, Division of Preventable Diseases,
Ontario Department of Health

THE main purpose of pasteurization of milk supplies is to act as a barrier against any infection that may have gained entrance into the raw milk reaching the consumer. When the public purchase milk which is purported to be pasteurized they are relying on the dairyman to provide a product which is free of infection, and are entitled to this guarantee. When, therefore, an outbreak of disease is definitely traced to the users of one milk supply which is supposed to be pasteurized, there has invariably been found some lapse in the technique of pasteurization which has allowed the infected milk to reach the consumer.

There have been two such occurrences in Ontario within the last few years. One, an epidemic of paratyphoid fever with 457 cases and 3 deaths, has already been reported in this journal.[1] In this epidemic it was shown that a certain amount of raw milk was distributed from the dairy without receiving the heat treatment. A more recent epidemic, one of septic sore throat, occurred in a small town, situated on one of the Great Lakes, which had a fairly large summer colony during the months of July and August. Largely through the demands of the summer visitors for pasteurized milk, two of the dairies operating in the town had installed pasteurization equipment. It was only when 27 cases of septic sore throat had been reported from the village that the local health authorities began to question the effectiveness of the pasteurization and requested an inspection.

It was found on investigation that all of those ill with septic sore throat had been users of milk from one dairy. No other milk product, such as butter or ice cream, was common to this group.

There were two dairies selling pasteurized milk in the village, and an inspection was made of both plants.

In the one plant which had no cases of septic sore throat amongst its consumers, the equipment and processing were found to be satisfactory. The pasteurizer was equipped with a self-recording thermometer (24 hour type). No cold pockets existed, the bottles and cans were thoroughly washed and sterilized with steam, and the bottles were capped mechanically. The operator of this dairy was a graduate of an agricultural college, and had intelligently purchased his equipment and understood thoroughly the operation of his plant.

In the other plant, amongst whose customers the septic sore throat had developed, a quite different picture was found. Milk was received from five farms. No attempt was made to cool the milk at the farm, but it was picked

[1] *Canad. Pub. Health J.*, **23**: 303 (*July*) *1932.*

up twice a day. The morning's milk was placed in the refrigerator at the dairy until the evening. When the evening's milk was brought in, it was mixed with the morning's milk and both were poured into the pasteurizer. The pasteurizing vat was fitted with no thermometer, a hand thermometer being used at various times during the heating process. A cold pocket of eight inches in length existed at the outlet valve. Capping of bottles was done by hand. No records were kept of pasteurizing temperature or time intervals. The operator stated that his practice had been to heat the milk to 139° F. and hold it for thirty minutes at this temperature. The temperature and holding period had been advised by the salesman of the equipment. The methods followed in can and bottle washing were unsatisfactory, and facilities for this purpose were lacking.

Investigation at the five farms resulted in eliciting the information that one man engaged in milking had suffered from an attack of erysipelas four weeks previously. Examination of the milk taken from each animal in this herd showed one to be excreting hemolytic streptococci of the human type.

Although the operator at this plant could not recall any instance in which the milk had not received the required heat treatment, he could produce no records to show that this procedure had been followed on every occasion. The epidemiological evidence pointed strongly to a portion, at least, of the infected milk having been distributed without adequate treatment.

In both these instances such an occurrence could have been obviated if the dairymen had been instructed as to the proper equipment to be purchased, and in the processing of the milk after he had received it. It would appear that an adequate system of inspection and instruction, with the licensing of all plants and operators producing pasteurized milk, is essential to prevent the recurrence of such outbreaks traced to improperly pasteurized milk.

Pasteurizing Equipment for Small Dairies

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Assistant Sanitary Engineer, Ontario Department of Health

THE health officer or public health official is often called upon to advise concerning the costs of pasteurizing equipment, particularly for small dairies. In considering these costs it is essential that each plant be equipped with machinery capable of attaining the desired results when properly operated.

So many factors are involved that it is not feasible to give definite costs of equipment. Each plant presents its own local problem. In an established dairy, the output from which is not likely to increase greatly, the equipment can be purchased to meet existing conditions. Where the sales are expected

to increase, the equipment, or parts at least, should be installed of sufficient capacity to meet the anticipated demand, or capable of easy extension. The location of the plant, its layout, and the kind of power available are important factors. The source of water supply and wash water disposal must be considered. The type of refrigeration, involving the supply of ice or source and reliability of power, affect initial and operating costs. The installation of second hand equipment may meet some conditions and the costs will be lowered accordingly. The purchase of labour-saving equipment may also affect the initial costs.

The necessary equipment consists of a modern pasteurizer with elimination of cold pockets; satisfactory cooler protected against flies and dust; bottling and capping machines (hand capping of milk or cream is to be avoided in dairy plants); sufficient can and bottle washing and sterilizing equipment; boilers of proper capacity for an adequate supply of hot water and steam; and adequate refrigeration. Fool-proof piping lay-outs are also necessary.

Different types of the same manufacture of the above items of equipment naturally vary in price. Consequently the following prices of plant equipment are approximate only and are offered merely as a guide. These prices will also vary from time to time.

Costs of Equipment for Complete Plant

A.—CAPACITY 75 GALLONS TO 100 GALLONS

Weight Scales	$ 50.00 to $ 70.00
Pasteurizer—Including flush type outlet valve	425.00 to 550.00
Milk Pump—(With electric motor)	95.00 to 100.00
Brine Pump—(With electric motor)	95.00 to 100.00
Piping and Fittings	60.00 to 75.00
Cooler	130.00 to 150.00
Cover for Cooler	65.00 to 80.00
Bottler—(manual)	185.00 to 200.00
Capping machine—(manual)	40.00 to 50.00
Bottle Filler and Capper (combined, manual)	155.00 to 280.00
Can Washer—Vat—(including steam jet)	50.00 to 75.00
Bottle Brush (revolving) including motor	35.00 to 40.00
Bottle Washer and Sterilizer (single case)	120.00 to 125.00
Recording Thermometers	115.00 to 125.00
Boiler (8 h.p. to 10 p.h.)	295.00 to 335.00
Refrigerator (ice box)	200.00 to 300.00
Mechanical Refrigeration Plant	2,000.00
TOTAL—(with ice refrigeration) (approx.)	$1,800.00 to $2,200.00

Additional charges necessary for dairy building and sundries, including bottles, cases, delivery waggons, etc.

B.—CAPACITY 300 GALLONS

Approximate Cost exclusive of refrigeration	$3,000.00

Costs of Equipment for a Dairy in Operation which Requires Additional Equipment for Carrying Out Pasteurization

(It is assumed that the cooling, bottling, capping, washing and sterilizing equipment is satisfactory and that the boiler capacity is sufficient to meet the additional demand for pasteurization.)

Pasteurizer—(75 gal. to 100 gal. capacity)	$425.00 to $550.00

The Need for Supervision of Milk Supplies

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Director, Division of Sanitary Engineering
Ontario Department of Health

THE need for closer supervision of milk supplies is becoming more and more apparent in all countries. The measures which now find general application consist of licensing the producers and distributors with periodic inspection by some local authority. There is seldom any attempt made to license the personnel in charge of plant operations where fluid milk is handled, but the certification of butter makers and cheese makers is a more or less accepted procedure and has been in use for some time. The question arises as to whether this form of fluid milk supervision results in adequate protection and reasonably uniform results.

There appears to be a definite trend to-day towards certification of various plant operators, including waterworks, sewage disposal and others having any direct bearing on public health. In many places these plants may be operated only under men who can produce certificates to show that they possess the necessary training and qualifications . All this is in addition to the usual inspection service maintained by the responsible authority. This would seem to be a specific indication that the public health can best be safeguarded by ensuring that the man in charge of any of these plants is properly qualified and is a type who will not tolerate inefficient or careless methods.

The situation in dairies processing fluid milk for human consumption is just as critical, if not more so, as in these other plants associated with public health problems. Under present arrangements anyone is allowed to operate a dairy plant without certification or proper training. It is the usual practice, when a pasteurizing plant is installed, to place someone in charge who probably has never had any experience whatever with equipment of this kind. Furthermore, he usually has had no contact with bacteriological information and is entirely unaware of the processes and objectives involved in the treatment of milk. He is given some meagre instruction by the man who installs the equipment and who in turn is probably as inadequately equipped to impart public health information as the one who is receiving it. If it is necessary that water treatment and sewage disposal plants should be in charge of fully qualified personnel, then it is obvious that the man who operates a milk plant requires even more supervision. The number of dairies is much greater than water and sewage plants and certainly the same degree of control over these is not as feasible as in municipal plants under civic employees.

Pasteurization is recognized as the feasible and economical means of safeguarding our commercial milk supplies. It involves a mechanical process and it is possible for defects to develop in the equipment as well as in the operating technique. This has been fully demonstrated by epidemics oc-

curring from supplies which were presumed to be pasteurized but which, on investigation, were found to be inefficiently processed, either because of defects in the equipment or lack of knowledge and care on the part of the operator. Close investigations of other pasteurizing plants in different centres have further emphasized these mechanical defects and have clearly shown that the operators were, in many cases, not adequately trained in the different details of plant operation to produce the desired results.

This is a serious situation when it is realized that the consumer places his confidence in the label on the bottle of milk and expects that adequate supervision is being given by those responsible. If this label on the bottle is to mean all that the consumer takes it to mean, it would seem desirable to adopt some further changes in the control and supervision of milk supplies.

The question of issuing certificates to plant operators, as one means of securing better supervision, has been receiving a good deal of attention recently. Its adoption would ensure that the operators of pasteurizing and other dairy processing plants would be familiar with the essential details of the processes and would be qualified to turn out a product thoroughly protected against all public health dangers. It will hardly be disputed that the operation of a plant, whether it contains good or defective equipment, is the major problem in milk control. By this measure supervision would seem to be directed to the important feature.

If certification were employed, some means would have to be provided whereby operators would be given instruction in the operation of a plant. They would not be permitted to take charge of such a plant until they had successfully demonstrated their capabilities in this field. This is no great difficulty. Similar provision has been made for waterworks employees. In the latter case some central authority conducts courses of instruction and sets the examinations.

The producers' and distributors' associations have taken an active interest in securing proper supervision over milk plants. It would appear that these organizations are solidly behind any move requiring properly qualified operators at the plants and supervision of the processes from beginning to end. This is a further indication that the producer and the distributor are vitally concerned with the good reputation established for the protection of the milk consumer. Any move in this direction would tend to eliminate a condition whereby the label on the bottle from the plant with all modern equipment and closest supervision means the same to the public as that from the less adequately controlled dairy.

Certification of milk plant personnel cannot be expected to eliminate the supervisory measures which are now in force. Inspection of milk production and processing will still be essential, but the task will be greatly lessened if the operators are properly qualified for their positions.

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THE PUBLIC AND SAFE MILK

WHEN an enlightened public opinion appreciates the hazards in the use of milk and not only demands the distribution of a safe product to the home but assures its final utilization by all age groups as a product still safe and incapable of producing infection, there will be no need for a special MILK NUMBER. To serve in bringing nearer that ideal, still far distant, this issue, devoted entirely to milk, is published.

Those interested in public health are already well acquainted with the various phases of the milk problem, the hazard, the extent and, too, the *solution*. Legislation providing, on paper, the solution could readily be written, but legislation, to be effective, must be based on public opinion. In the final analysis it is public opinion, public demand, public standards that, with or without legislation, determine our practice. The antagonism to pasteurization, to any improvement, once so vocal, has for the most part disappeared but there is little evidence, in spite of a great increase in the per capita consumption of milk, of a really enlightened demand for a safe milk. In fact, rural life is largely content that its past practice is sufficient for to-day. Rural life does not recognize any hazard in milk, to say nothing of failing to provide a solution. This lack of public appreciation of the milk question is our failing. Why should the public appreciate the situation? What do they know of the problem? How can they know anything of the problem? Their information has been largely confined to scare headlines of spectacular epidemics which are as quickly forgotten. They have not been given the details through which we have learned the hazards of milk and the solution—the details necessary for the formation of an enlightened opinion. The public concerned are, for the most part, parents, and most parents are normal and have the health of their children as their deepest concern. They welcome anything which will give them assurance of the health of their children. They have faith in the family physician and believe implicitly what he says. But they are intelligent beings who have a right to think and it is our duty to provide them with the material

which should receive their consideration. If we fail to provide them with the convincing data in regard to milk which come continually to our notice, we need not look for much active co-operation towards a safe milk supply. But if we take the public into our confidence, and give them, not our devitalized conclusions, but the actual observations on which the conclusions are based, the public will respond in a perfectly normal manner. Safe milk will become a general demand of an enlightened, intelligent public opinion. Milk alone offers a wide field for public health education.

THE ATTITUDE OF PRODUCERS AND DISTRIBUTORS

IN 1921 the Saskatchewan Dairy Association in convention unanimously adopted the following resolution:

> "WHEREAS the proper pasteurization of milk has been proven an important safeguard to the health of the consuming public;
>
> "BE IT THEREFORE RESOLVED that this Association go on record as favouring legislation in cities making it compulsory that all milk or cream sold wholesale or retail in such cities be scientifically pasteurized."

In the intervening years endorsation of the principle of pasteurization has been given and reaffirmed by the National Dairy Council of Canada and by the official associations of producers and distributors in the various provinces. In 1933 the Ontario Milk Producers' Association and the Ontario Milk and Cream Distributors' Association have urged the adoption of a province-wide law requiring pasteurization in towns and cities, and the latter body has further urged that, as a safeguard to proper pasteurization, operators be licensed by the provincial government. This is a significant development.

It is more significant in that a thorough study of all existing conditions was made previous to adopting the resolutions to which reference has been made. The study revealed that the vast majority of producers desired and endeavoured to provide good quality milk, but that the selling price was unfairly low and was kept down by the so-called "bootleg" milk—i.e., milk offered for sale below the known cost of production of milk of sound quality. Another factor important in reducing the producers' fair return was the milk produced in excess of that required. The obvious solution for this condition was the use of more milk, but the advice to "Drink More Milk" was likely to go unheeded unless the safety of the milk could be assured. Realizing that pasteurized milk is the only safe milk, the producers and distributors have adopted universal pasteurization as their objective, realizing not only that a safe product is thus assured to their customers who can thereby be urged with confidence to drink more milk, and that

the milk-borne disease will be greatly reduced, but that, with a provincial standard, a fairer price will be possible for the producer.

With unanimity of opinion of producer, distributor and consumer the day of safe milk appears appreciably nearer.

LEGISLATION AND PASTEURIZATION

IN a comprehensive report presented to the Canadian Public Health Association in 1925, the special Committee on Milk Problems under the chairmanship of the late Dr. M. M. Seymour of Regina, stressed the importance of legislation which would ensure to the consumer the safety which the term "pasteurized milk" implies.

To permit of the distribution of a safe milk, there must be a properly equipped plant and a capable, trustworthy staff of healthy operators. Every step of the handling of milk in the dairy requires intelligent co-operation on the part of the employees. Pasteurization may be conducted with meticulous care and yet the milk, when distributed, may be dangerous to health because of failure to sterilize the bottles properly or to provide adequate safeguards in the capping and after-handling of the milk. For effective control there must be an effective local by-law. Model milk by-laws have been prepared by Provincial Departments of Health for the use of municipalities. Such by-laws govern production and pasteurization procedures and require the licensing of all dairies.

Too often the dairyman selects the pasteurizing and other dairy equipment without an adequate personal knowledge and without an appreciation of the essential requirements for the production of safe milk. If the plans of the new installation could be studied by an experienced public health engineer, the dairy owner would receive valuable assistance. He would be assured that if the plans of his new building or addition are approved, the plan is a satisfactory one and that the suggested equipment will meet the requirements, if properly operated. The value of such approval of the plans of municipal waterworks and sewage disposal plants by a Provincial Department of Health is established. Municipalities have been saved many thousands of dollars by the counsel and advice of the Provincial Departments of Health in proposed expenditures for such plants and, of far greater significance, the health of the people of the related communities has been safeguarded. But local supervision cannot provide such service. Provision, therefore, for the filing of all plans for new pasteurizing plants, or additions thereto, with a Provincial Department of Health for approval is logical and necessary. Three provinces—Saskatchewan, Manitoba and Quebec—have already incorporated such provision in the provincial legislation; in Alberta new milk legislation is being prepared in which provision is being made for provincial approval of the equipment and layout.

The filing of pasteurization plans is closely associated with the licensing of all such plants. In Manitoba the provincial legislation requires every dairy undertaking pasteurization to make application to the local municipality for a licence, and approval by the Provincial Department of Health must be obtained before it is granted. The licensing of all pasteurizing plants through the local municipalities, with the approval of these licences in each instance by the Department of Health, makes possible a system of adequate supervision. Licensing of such plants is a reasonable requirement.

In several of the provinces legislation has been enacted which requires that every creamery be licensed, that all cream be pasteurized, and that strict supervision be exercised by the government, in order that the quality of butter be maintained at a high standard. It may be fairly asked: "If it is essential to supervise every creamery to ensure that pasteurization is carried out properly and that due care is exercised in every step of butter production, is it not of greater importance to require the licensing and inspection of all pasteurization plants delivering to consumers supposedly safe milk?" Such a plan should be province-wide in scope. The milk supply of a municipality is as urgent a problem as its water supply. Both must be safe if many lives are not to be sacrificed each year.

The paramount importance of regular inspection by those competent to detect defects in equipment as well as to appraise the efficiency of operation, is recognized, but the best system of inspection is helpless if the operators charged with the responsibility of pasteurizing and other important procedures are unintelligent, lacking in both interest and appreciation. No one questions the wisdom of requiring proof of the ability of an individual to operate a steam boiler, to do the work of any one of a number of trades, or to drive a motor car on the city streets. Legislation is essential which will require that only those who have submitted satisfactory evidence of competency should be allowed to operate pasteurization equipment, as on their intelligence and reliability depends the health of thousands of persons in the community. Pasteurization is as safe only as its weakest link. Too often the operator is inadequately instructed in the operation of the plant and has no understanding of the elementary principles. No amount of supervision will avail and no type of equipment can prevent disaster if untrained and uninformed persons are allowed to operate pasteurizing and other essential dairy equipment.

Licensing of operators is a step which strengthens the work of inspectors, safeguards pasteurization and renders more effective the whole system of control. It facilitates regular medical examinations and makes more effective the regulations made under the Public Health Acts of the various provinces respecting communicable diseases as affecting dairy operators. The safeguarding of milk rests on adequate legislation which, in turn, depends on an intelligent public opinion.